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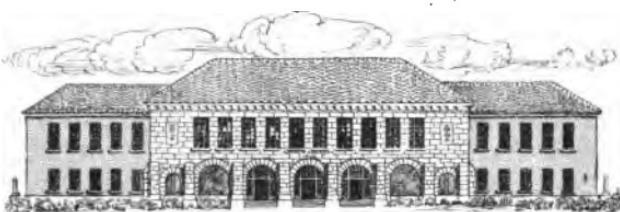
EDUCATIONAL SCHOOL READINGS

STORIES
OF
COUNTRY LIFE



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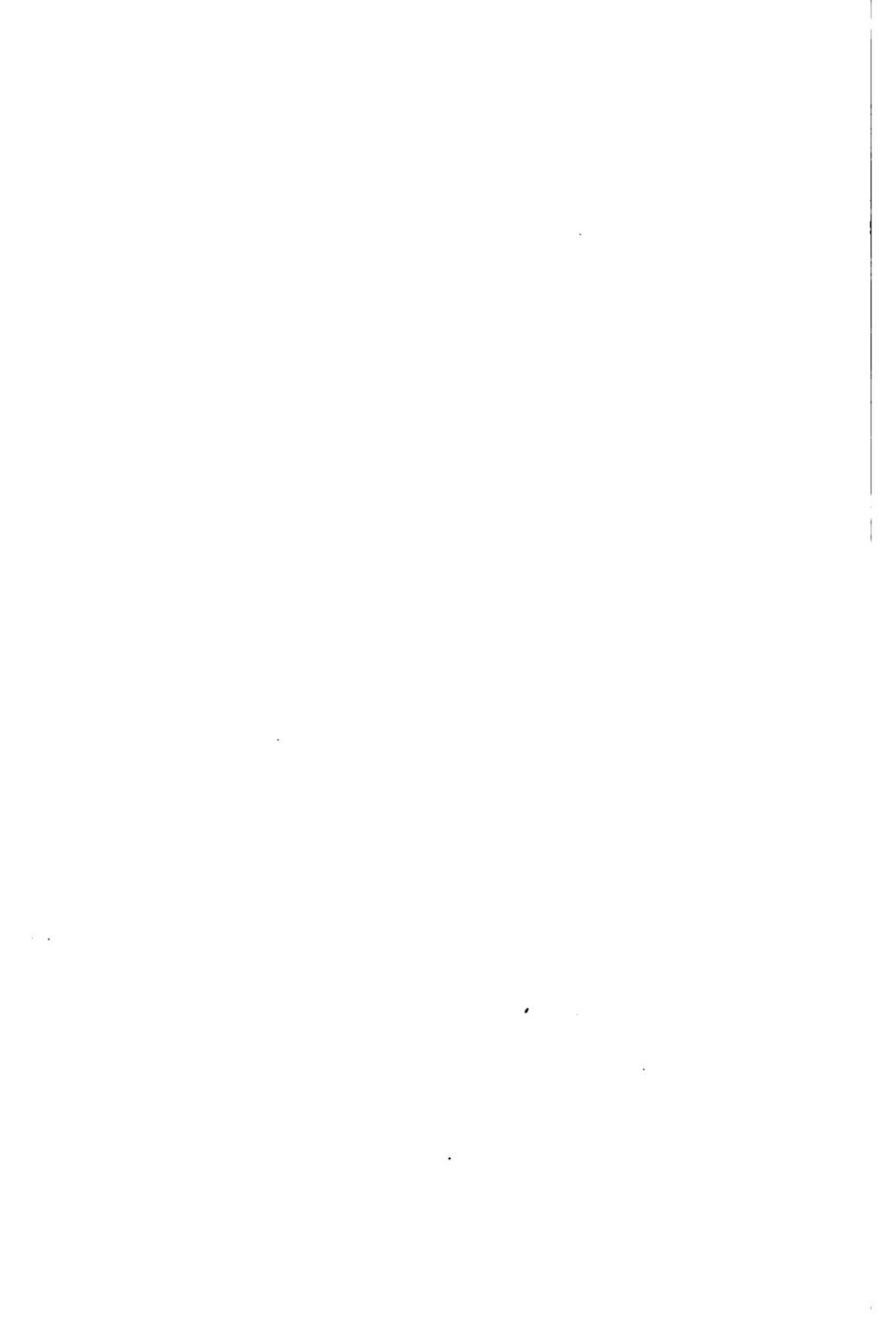
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ECLECTIC SCHOOL READINGS

STORIES OF COUNTRY LIFE

BY

SARAH POWERS BRADISH
AUTHOR OF "OLD NORSE STORIES"



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ENTERED AT STATIONERS' HALL, LONDON.

COUNTRY LIFE.

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ОСИАЛ. ОДОВАЛО СИА. ОУ
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PREFACE

THESE stories are, in the main, recollections of a childhood spent on a northwestern farm. They aim to emphasize the attractiveness of life in the country and to add to its charm by awakening an intelligent interest in its many activities.

The order of the stories is governed partly by the sequence of seasons at which the various industries can be best observed, and partly by the logical relation of these industries to one another. Thus we have early in the book stories of a wheat field and of the planting of corn, followed later by descriptions of harvesting, stacking and thrashing, the buying and selling of wheat, its storage, and the grinding of wheat into flour.

The stories relating to lumber, coal, and iron, and the industries to which they give rise, are scattered among the farm stories to lend variety to the themes and to give the child a broader view of industrial life.

The stories of animals are true stories of actual occurrences.

S. P. B.

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STORIES OF COUNTRY LIFE

I. A MORNING IN MARCH

WALTER KING is a Minnesota boy. He is the son of a farmer, and he means to be a farmer when he is a man.

When he was ten years old he thought he was old enough to begin to learn, and his father thought so too.

One morning in March he awoke early. The sun had been shining all the day before, but light snow had fallen during the night. The trees and shrubs and roofs and fences were covered with beautiful frost feathers.

Walter dressed quickly and ran downstairs to feed the chickens, and pour grain into the feeding boxes for the sheep.

When he had finished his work at the barn, he pumped a pail of fresh water for his mother, and came into the house, as hungry as a farmer boy ought to be.

After breakfast Mr. King said, "Come, Walter, let us go to the sugar bush."

There is a grove of fine maple trees on the farm, which are full of sweet sap in early spring; and that is the reason the grove is called the sugar bush.

They found the men already at work, taking care of the sap. Holes had been bored in all the large maple trees, and spouts had been driven into these holes. Buckets hung beneath the spouts to catch the sap, which was dripping very fast.

As the buckets were filled, the men took the sap away to the sugarhouse, a little cabin built in the grove. It had one room with a large stone fireplace. A huge pan was set into a stone arch over the fireplace. The men had filled this pan with sap, and a fire was burning under the pan.

The sap looked like water, but tasted sweet. It began to boil soon after it was poured into the pan; and after it had been boiling for some time, it turned brown. It was maple sirup then, and was strained into another pan. There was a fire under that pan too.

Some eggs were beaten to froth, and stirred into the sirup. When it began to boil, tiny bits of wood and dust came up to the top of the sirup, and clung to the egg froth. The egg and wood and specks of dust were all skimmed off together. The sirup was

then very clear, and of the color of amber. They boiled it until it was very thick.

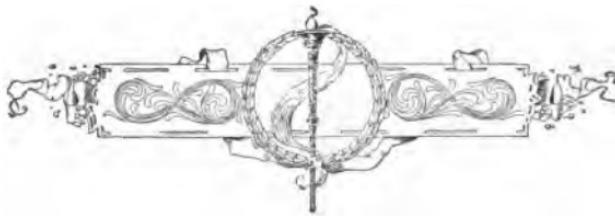
Walter pressed some clean snow into a bowl, his father poured some of the thick sirup over the snow, and it became stiff like wax. Walter liked the maple wax very much.



Collecting Maple Sap.

When the sirup had boiled enough, it was dipped into tin molds of different shapes and sizes. As it cooled, it hardened to sugar; and, when quite cold, the molds were turned upside down on the shelves. When lifted off, they left rows of maple sugar cakes. Some of the cakes were large, some were small, some square, some of fancy shapes. Walter liked best the pretty little scalloped cakes.

Some of the sirup was poured into large earthen bowls. While it was cooling, it was stirred with a big wooden spoon. The grains of sugar appeared; but the stirring kept them separate. They called it "stirred sugar," and it looked like granulated sugar.



II. VARIOUS KINDS OF SUGAR

"Does all our maple sugar come from maple trees?" asked Walter.

"Yes," said his father; "but most of our sugar comes from grass."

"From grass, Papa?" and Walter's blue eyes opened wide.

"A kind of sweet grass that grows in hot countries," said Mr. King. "It is called sugar cane. It is taller than corn, the stalks are thicker, and it grows from slips, which are cut from the top of the plant. In the West Indies these slips are planted in moist, rich soil, at any time from June to August, and the cane is ready to harvest in about a year and a half. The stalks are cut close to the ground, and the roots are covered at once with waste and ashes from the sugar mills. The planters say this waste is the best food for sugar cane."

"New canes shoot up from the roots. These canes can be cut the next year; but they do not grow so large as the first-year canes. Canes are cut from the same roots for two or three years. At



Cutting Sugar Cane.

last they are so small and contain so little sugar that it does not pay to harvest them.

"When the canes are taken to the sugar mills, the leaves and upper joints are stripped off, and the stalks are passed between heavy iron rollers. These rollers press out the sweet juice, which is thick and frothy, and yellowish green in color. It is strained through many sieves, and runs through troughs to great iron tanks. These tanks hold from six hundred to eight hundred gallons; they are called purifiers.

"The juice is made clear in the purifiers. It is

slowly heated almost to boiling, and a thick scum rises to the top of it. This is skimmed off, as you saw us skim the maple sirup.

"After being skimmed, the juice passes through many pans. There is a fire under each pan, and the juice becomes thicker as it goes along, until, in the last pan, it is very thick indeed. As it cools, sugar crystals appear in the sirup, and it is now sugar and molasses, mixed. When it is cold, the sugar is separated from the molasses and packed in hogsheads and left to drain in the curing house. The molasses that drips from the sugar is the molasses with which we make gingerbread.

"The sugar is sent to the sugar refineries, where it is dissolved and filtered and purified. Then it is separated into different grades, and sent to warehouses. The merchants get it from the warehouses, and sell it to us.

"Sorghum is a different kind of sugar cane, which was found in China. It is raised from seed. Some years ago a traveler brought the seed to this country, and it grows very well in our climate.

"We plant the seed in the spring, and cut the canes in early fall. The stalks are pressed between rollers to get the juice, which is heated and purified, like cane juice. We do not get much sugar from

"our sorghum; we get more sirup, and the sirup is very good.

"Much of our sugar is obtained from beet root."

"From the common beet root that we have in our garden?" asked Walter.



A Sugar-beet Farm.

"No," said his father, "sugar is made from the white sugar beet. Millions of acres of sugar beets are grown every year in France and Germany, and we are growing a great many in this country too.

"It is harder to get the juice from the beet than .

from the cane, and beet juice is not so sweet as cane juice; but the beets can be grown so easily that farmers think this will be a good way to get sugar.

"The beet juice is filtered and cleansed in the same way as cane juice. But it is more watery, and has many things in it besides sugar; so that it is more difficult to make sugar from it than from the cane.

"We shall plant some sugar beets this year. Perhaps we can go to the factory next fall, and see how they make the sugar."

III. THE WHEAT FIELD

The snow was gone and the sun shone bright and warm. A robin peeped in at Walter's window, and sang a merry song. Walter rubbed his eyes, and thought of Speckle on her nest in the straw stack. He sprang out of bed and ran to the barn-yard as quickly as he could.

He found ten little downy chickens peeping through old Speckle's wings. He carried the mother hen and her little ones to a safer place, and gave them their breakfast.

After he had eaten his own breakfast, his father said, "Do you know where we are going to sow wheat this year, Walter?"

"I think in the field south of the barn," said Walter.

"What makes you think so?"

"Because we plowed it last fall; and I think we plowed it to have it ready to sow wheat early in the spring."

"That is right," said Mr. King. "We sow our wheat in early spring; but in many places wheat

is sown in the fall. There are different kinds of wheat. The wheat that is sown in the fall is called winter wheat; wheat sown in the spring is spring wheat.

"The frost is all gone now, and the sunshine has dried the wet places. The ground is soft and moist



The Harrow.

and 'ready to work,' as the farmers say. We will go to the barn and get ready to go to the field."

John was harnessing the horses, and James was getting out the harrow. While Walter was looking at the strong iron "teeth" of the harrow, John hitched the horses to it, and James drove to the

field and then back and forth over the plowed ground. The harrow teeth crumbled the soil, and leveled the edges of the furrows left by the plow in ridges, and made the ground very fine and soft.

"Now," said Mr. King, "it is time to bring out the seed wheat and the seeder. Here is the seed wheat in this bin."

"It looks like the other wheat," said Walter.

"It *is* like the other wheat," said his father; "only it is better. We took pains to select the largest and best-ripened kernels for seed. Do you remember how we screened it?"

"Yes, Papa," said Walter; "we screened it in the fanning mill. The big fans in the fanning mill blew out all the dust and chaff. The weed seeds dropped down, with the small kernels of wheat, under the mill."

"Then," said Mr. King, "we put a coarser screen or sieve into the fanning mill, and passed the cleaned wheat through again. This time the undersized kernels fell out, and left only the very best wheat. This we saved to sow in the spring, and now we shall put it into bags and take it to the field."

"There is the seeder," said Walter. "John has just brought it out from the tool house."

"You may drive this load of seed wheat into the field," said his father.

When they reached the field John took a bag of the wheat from the wagon, and emptied it into the long box on the seeder.

He showed Walter the rollers under the shaft that passed through the box. Then he started the horses, and moved the lever at one end of the box.

He said he "threw it into gear." He meant that, by means of the lever, he let the wheat fall to the rollers, which sent it on to the "scatterers," or tubes from the bottom of the box.

As he drove along, the shaft turned around; the wheat fell from the rollers to the scatterers and dropped to the ground. It was covered with the fine soft soil by the "hoes" in the rear of the seeder.

The harrow was driven over it, to make sure that every kernel was hidden in the ground.

So the wheat was sown.

IV. THE CHIPMUNKS

"Mamma, Mamma," cried Walter, "here are some chipmunks, right by our door!"

"So there are," said his mother. "Here are some nuts for them."



The Chipmunk.

Every morning Walter left a breakfast of nuts near the door of the chipmunks' house. They lived in a house underground in one corner of the dooryard. Their door was only a little round hole in the ground. Walter was very careful not to frighten them when their little bright eyes peeped out of that hole.

They soon learned to expect their breakfast; and if Walter did not bring it early enough in the morning, they would come up on the porch, and tap at the screen door.

Soon they found a small place under the screen, and learned to flatten their little bodies and make their way into the dining room.

One day Walter gave them a cracker. After that they left their nuts and waited for crackers.

But they liked cookies best of all. They ate pieces from Walter's hand. When they had eaten enough, Walter gave them whole ones. Then each took a cooky, and made a wheel of it, by standing it on its edge.

They took their cooky wheels away, by walking on their hind legs and rolling the cookies with their paws. Walter always opened the door for them, and they rolled their cookies across the grass, in the same way, to feed their little ones.

V. THE BLACKSMITH SHOP

"Now the wheat is sown," said Mr. King, "we must get ready to plant corn. John says the plow points are dull, and the corn ground is not plowed yet. Jack needs new shoes, and Dolly's shoes are loose."

"Oh, Papa," said Walter, "let me drive Jack and Dolly to the blacksmith shop to get new shoes. Put the plowshares in the wagon, and I can take them along too. Mr. Lee will let me stay and see him do it all."

"Yes," said Mr. King, "you may go. Ask Mr. Lee to look at the wagon tires too."

Mr. Lee was the blacksmith. He was very glad to see his little friend, Walter, and said he would be ready to shoe Jack in a few minutes. He was mending a corn planter for Mr. Brown just then. Walter tied the horses and went into the shop.

He always liked to look about in Mr. Lee's shop. He counted the horseshoes hanging from the rafters. He looked at the hammers and the sledge hammers, at the flatters for smoothing the hot iron,

at the fullers, and the other tools for making the iron into different shapes. He saw the tongs of different sizes and different forms for holding the iron and all sorts of chisels for cutting the iron both when it is cold and when it is hot. He noticed that the fullers and the flatters and the chisels had curious handles made of wood twisted around them. He saw the tanks of water in which the hot iron is cooled, and observed a great many tools, the names of which he did not know.

He lifted some of the tools, and said he felt stronger after he had lifted the big sledge. He liked to hear the ring of the hammers and anvil, and he never tired of watching the sparks fly from the white-hot iron, when the blacksmith's blows first fell upon it.

There was a great pile of coal at the end of the forge, upon which he climbed, to look into the roaring fire. When he had watched the fire long enough, Mr. Lee let him take the handle of the big bellows. He blew the fire until bright sparks flew up the black chimney. He looked longingly at all the bits of iron that lay beside the forge, and Mr. Lee gave him some of them. He filled his pockets with the pieces he liked best.

Now Mr. Lee was ready for Jack, and Walter unhitched the horses, and led them into the shop.

Jack needed two new shoes. Mr. Lee took down a new steel shoe; it was too large for Jack's foot. He took down another; it was too small. But the next one was just right.

He heated the shoe red-hot in the forge, and Walter worked the bellows, while the shoe was being heated.

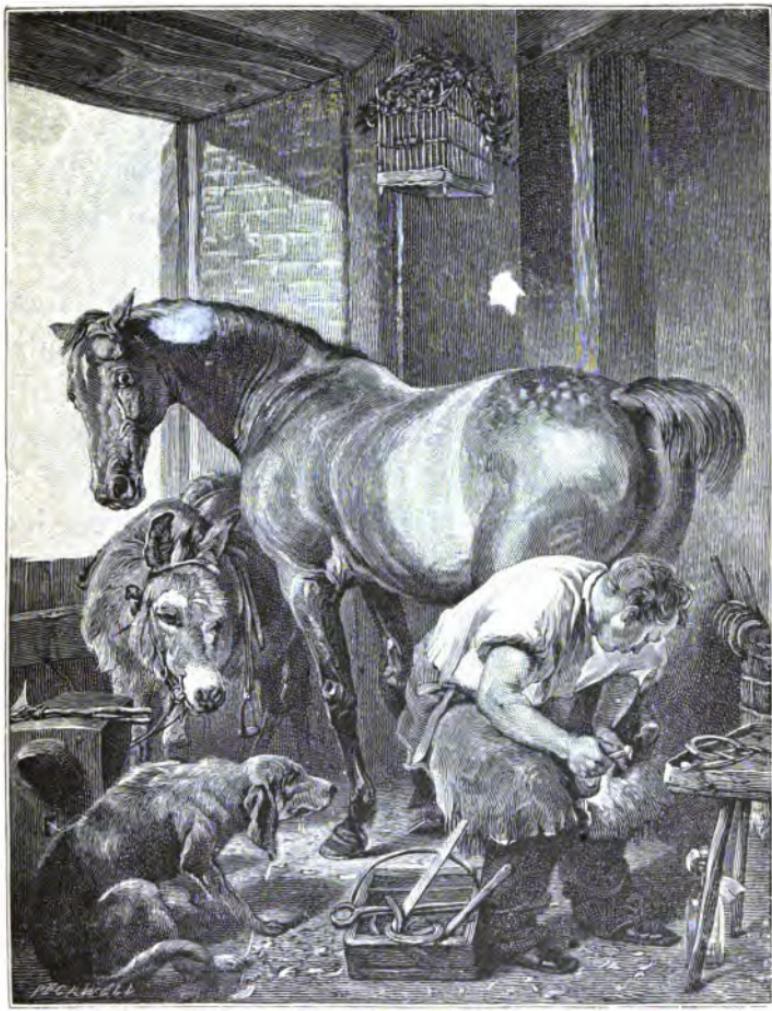
The blacksmith took it from the fire with the long tongs, and with his hammer turned up the two ends to make calks, to strike into the ground to keep Jack from slipping. Then he drove a steel calk into the front of the shoe.

He put the shoe into a box, which he called a "shoeing box." There were horseshoe nails and a hammer, and some other tools in the box. He set it down beside Jack, and lifted Jack's foot. Jack turned it bottom side up.

He pared the bottom of the hoof until it was flat and even. Then he laid the shoe on this flat surface, and fastened it with eight horseshoe nails. There were eight little holes in the shoe for nails. He fitted another shoe for Jack, and put it on in the same way.

Then he looked at Dolly's shoes, and said they were loose.

He placed a little bar of iron against the points of the nails, where they came through the side of



From the Painting by Sir Edwin Landseer.

Engraved by Henry W. Peckwell.

The Blacksmith.

the hoof, and struck the heads of the nails with his hammer, so that the points were turned by the iron bar. In this way he made the shoes tight.

Walter led the horses out of the shop, tied them under the shade of a tree, and brought in the plowshares.

Mr. Lee put them into the fire on the forge. When they were bright red he beat them with the hammer until the cutting edge was thin and sharp. Then he dipped them red-hot into cold water, to harden the steel.

When they were cold he made the sharp edge smooth and even with a file.

One of the wagon wheels rattled, and Mr. Lee said the tire needed "setting." He took the wheel off the wagon, and knocked the iron band off the wheel with his hammer. The iron band was the tire. He said that the wheel rattled because the tire was too large.

He cut a little piece out of the tire with his chisel, and welded it together again. He laid it on the ground and brought some little blocks of wood and made a fire around it.

When the tire was hot he laid the wheel on a bench, which had an open place in the middle for the hub, so that the rim lay flat on the bench.

Then he placed the hot tire on the rim of the wheel and drove it down with his hammer.

He poured water on it to cool it quickly, so that the hot tire would not burn the wood rim of the wheel. As it cooled, it grew tighter and the wheel no longer rattled.

He helped Walter put the wheel on the wagon again, and Walter put the plowshares back in the wagon box, and hitched on the horses.

Walter said he would be a blacksmith if he had not begun to learn to be a farmer.

It was noon when he drove Jack and Dolly into the yard at home. His father said, when he came out to meet him, "You have saved half a day for me, my boy."

"We could not go on with our work without the blacksmith's help, could we, Papa?" said Walter.

"No, indeed," said his father; "and he could not do his work without our wheat to make his bread, or without our money for iron and coal."



A Cornfield.

VI. PLANTING CORN

One pleasant morning in May Walter went out to the cornfield. The ground had been plowed and harrowed. The men were planting the corn in "hills," which were in rows about four feet apart.

"Why are you so careful to have the corn dropped into just those places?" asked Walter.

"Because the cultivator must be driven between the rows," said Mr. King. "If the rows were not straight, the horses would step on the young corn."

"The cultivator loosens the earth, and tears up the weeds. The corn is 'cultivated' two or three

times while it is growing. By midsummer the corn will be so large that the horses cannot walk between the rows."

"Do you drop a handful of corn into every hill?" asked Walter.

"We mean to put seven kernels into every hill," said his father; "but they do not all grow. Do you remember the old rhyme about planting corn?

"One for the blackbird,
One for the crow,
Two for the cutworm,
And three to grow."

VII. NANNIE

Last year Nannie was a little motherless lamb. Walter fed her and took care of her. She had a little house in the back yard, and she did not live with the sheep till winter.

When her little lamb came she was very fond of it, and the other sheep and lambs troubled her. So Mr. King let her stay with her lamb in the grove west of the house, and Walter looked after them.

One day Nannie bleated at the gate. We thought she was calling Walter because she was lonely. She bleated again and again.

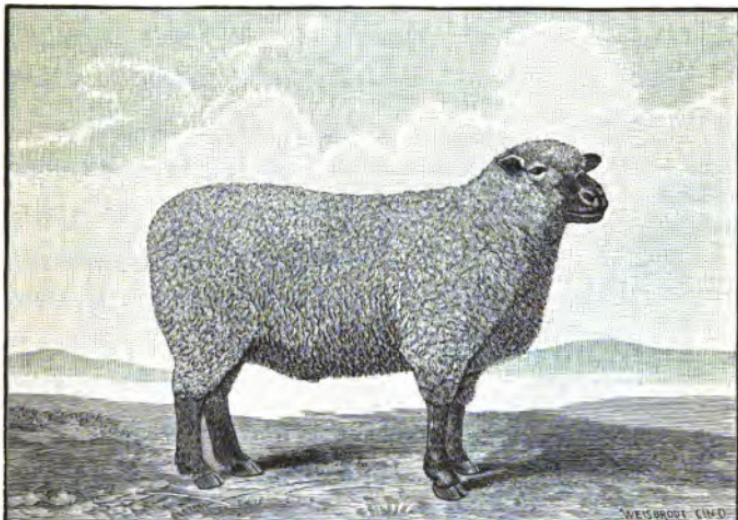
At dinner time, she managed to open the gate, and came to the dining-room door, bleating sadly.

Mr. King said: "Nannie wants something. Let us go with her, Walter."

Nannie ran off down the path. At the gate she looked back. She saw Mr. King and Walter coming, and ran on again. She kept looking back to see whether they were coming, as she led the way to her lamb.

It was lying on the ground. It had put its head

between two little trees, the trunks of which grew close together, and held the lamb's head fast. The little lamb did not know how to turn its head to get it out again.



Nannie

Mr. King pulled the little trees apart, and the lamb ran to its mother. Nannie said "Baa," and licked Mr. King's hand.

She did not bleat any more; for she had only been asking for help for her lamb.

VIII. THE KINGBIRDS

"Mamma, there is a bird's nest in the fir tree," said Walter.

"Yes," said Mrs. King. "The kingbirds are building there."

"Do you mean those little birds with gray heads and backs and white breasts?"

"Yes, but under the feathers on the top of the head you will find a bright yellow or orange-colored spot. These birds are called kingbirds."

"But, Mamma, they are very plain, small birds. Why are they called kingbirds?"

"Because they are strong and brave and able to conquer much larger birds. The jays wanted to build in that fir tree, and you know how the little kingbirds drove them away."

"There is a hawk," said Walter. "He is flying



The Kingbird.

over our chicken yard. Shall I call James to bring his gun?"

"No," said Mrs. King; "the kingbirds will take care of the hawk."

Walter's eyes opened very wide; but he said nothing. He was waiting to see what the little birds would do.

The hawk came nearer. He spread his broad wings and sailed slowly over the poultry yard. Walter thought he was trying to decide which chicken would make the best supper. The little birds flew up from the fir tree. Walter could see the great beak and strong talons of the hawk. He thought the kingbirds would be torn to pieces, and shut his eyes, so as not to see. "Look! Walter, look!" said his mother.

The little kingbirds were chasing the hawk. They flew over him, and under him; they darted at his head; they picked his eyes, and plucked his feathers.

The big bird flew away as fast as he could. The kingbirds followed as far as Walter could see. They came back to their nest; but the hawk had been frightened away.

IX. THE BLUEBIRDS

There were many squirrels in Mr. King's yard. They often chased each other up and down the trees, and through the branches, and ran along the



Squirrels.

top of the fence. They were very playful, and Walter liked to watch them.

He liked to watch the birds, too. One day he saw his old friends, the bluebirds. "Mamma," he cried, "the bluebirds have come. They are building a nest in a hole in the gatepost."

"I am sorry we did not have that place stopped up," said Mrs. King.

"Why, Mamma, don't you like bluebirds?" asked Walter.

"Yes," said his mother, "I like bluebirds; but I am sorry to have them build in the gatepost. Their nest was torn up there last year, and the year before, too."

"I'll watch it," said Walter.

The nest was soon finished. In a few days four pretty blue eggs lay in the little nest. Walter watched it, as he had said he would.

He felt sorry for Mrs. Bluebird. Mr. Bluebird just sat and sang in the maple tree over her head. He did not bring her a worm or a kernel of grain, or even a nice ripe berry from the garden. "Selfish Mr. Bluebird," said Walter. "He does not even help her to find food when she leaves the nest. He only sits there in sight of the blue eggs and sings."

One day Walter saw a squirrel stealing along the top of the fence. When the squirrel came to the



The Bluebird.

gatepost, down darted Mr. Bluebird. He pecked at the squirrel's eyes, nipped his ears, and pulled out tufts of hair from the top of his head. The squirrel ran away. He did not have Mrs. Bluebird's eggs for supper.

But Mr. Bluebird flew up into the maple tree, and sang with all his might.

When Walter told about the battle of Mr. Bluebird and the squirrel, he said: "I shall not say 'selfish Mr. Bluebird' any more. I shall say, 'brave Mr. Bluebird.'"

"Yes," said his mother, "thoughtful and watchful Mr. Bluebird, too."

"Gallant Mr. Bluebird," said Uncle Fred, who was a soldier.

X. THE NEW FLOOR

"John says we must have a new floor in the stable," said Mr. King. "What shall we do about it, Walter?"

"I think," said Walter, "the first thing will be to get some boards from the lumber yard, and some nails from the hardware store."

"Very well," said Mr. King, "get your hat, and we will go to the lumber yard."

The wagon box was taken off the big farm wagon, and Mr. King made a good seat with a board and some horse blankets, and called, "Walter, climb up," and they started for the lumber yard in the village.

Mr. King bought some heavy planks. The men at work in the lumber yard lifted them upon the wagon. The planks were bound together with strong ropes and chains to keep them in place, and Mr. King turned his horses' heads toward home.

"Papa, where does all the lumber come from?" asked Walter, as they drove along the quiet road.

"Most of it comes from the pine forests," said his

father. "Do you not remember going to Lake Superior, last fall?"

"Oh, yes," said Walter; "I remember the long ride through the pine woods. Sometimes the deer scampered away from the track, when the train whistled."

"Yes," said Mr. King. "You were afraid they would lose their antlers in the thick underbrush."



Red Deer.

"But they did not," said Walter. "They threw their heads back, and their wide-spreading antlers lay on their shoulders. They leaped over the thickets and dashed away into the forest. I remember the Indians too. They had tents in the woods."

"Yes," said Mr. King. "They set poles in a circle in the ground, and bound them together at the top. They peeled bark from birch trees, and fastened it over the tent poles. This was their house or wigwam."

"They left an opening at the top, where the poles were bound together; and made their fires in a hole in the ground, in the center of the wigwam. The

smoke passed out through the open space which served as a chimney."

"There was a kettle hanging over the fire in one of the wigwams," said Walter. "They were cooking venison for supper."

"Yes," said his father, "the carcass of a fine deer hung from a tree near the wigwam. The hide was



Indian Squaw and Papoose.

stretched over the poles to catch the smoke from the fire. They were tanning it to make leggings."

"Mamma gave one of the squaws some medicine for her sick papoose," said Walter. "And the next day, an Indian, the baby's father, brought us some presents, a carved ladle for Mamma, and a bow and arrows for me. The bow was painted with gay colors, and the arrows were tipped with feathers."

"He said the papoose's name was 'South Wind,' and Grandma gave him something nice for little South Wind to eat. He looked pleased, but he knew only a few English words. He seemed to think 'good-by' meant 'thank you'; for he said 'good-by' to Mamma two or three times. After he had gone out to the gate, he came back to say, 'Old woman, good-by.' Mamma said he wanted to thank Grandma too."



XI. THE LOGGING CAMP

"Now we are halfway home," said Mr. King. "You asked about lumber, and we have been talking about deer and Indians. Do you remember the log houses we saw near the Indian wigwam?"

"Yes, Papa," said Walter, "they stood in the edge of the pine woods, near a clearing."



Cabin of Round Logs.

"That was a logging camp," said his father.

"When the snow comes, in the early winter, those houses are full of men. In summer the men stay in their own homes; but in winter they go into the woods, to cut trees, and live in those houses until the ice melts in the spring."

"They have a cook who serves their meals on long tables in a big kitchen. They have a hearty breakfast before daylight, and as soon as day dawns,

they go out with sharp axes and saws, to cut down the great pine trees.

"They decide in what direction they wish a tree to fall, and cut a deep notch in the tree on the side toward the place where they want it to lie. The

tree will fall toward the notched side. They call it 'felling the tree.'

"Then two men bring a long saw with a handle on each end. They



Felling Trees.

call it a cross-cut saw. The saw is about six feet long, the handles stand straight up, and are so long that a man can take hold of one with both hands. Each man takes hold of a handle. They saw into the tree just opposite the notch.

"When the saw has cut well into the middle of the trunk, the tree slowly breaks off, and falls with a crash just where they want it to lie. They take the cross-cut saw again, and saw the tree trunk into logs from twelve to twenty-four feet long.

"The mark of the owner of the tree is cut into each log with axes.

"When the logs are ready to be moved, a man comes with a team and a short sled. This sled has no tongue. It is made so that it can be easily drawn about among the logs and stumps. A log is rolled upon the small sled by means of a 'cant hook.' A cant hook is a stout shaft of wood, with a swinging hook near one end, which catches into the bark of the log. It is used only for rolling logs.

"One end of the log is bound, by a chain, to the front of the sled, and the other end is allowed to drag on the ground. The horses or oxen are hitched to the chain. This binds the log more firmly to the sled. The team is then driven to the skidway, the place where the logs are piled, to wait till they can be drawn to the lake or river.

"If possible, the skidway is built on a hillside, so that the 'head block' can be on the lower side. The head block is a log about eight feet long and as high as the sled that is to haul away the logs. The 'skids' are two small logs that lie across the head block. They are the bodies of two small trees, not large enough to make saw logs. One end of these rests upon the head block; the other on the ground farther up the hillside. The logs are rolled



Logging.

along the skids. The first log rests upon the head block, and the others are piled upon the skids.

"By and by a teamster comes with a strong sled, drawn by a heavy team. Sometimes there are two horses or two oxen; often there are four horses or four oxen. The sled is driven up to the skidway. The log that lies upon the head block is rolled to its place on the sled.

"Another log rolls down to the head block. This log is rolled upon the sled; and so on, till the first row, or tier, is full.

"The logs on the sled are now higher than the head block. The men bring two short skids. One end of these skids rests on the logs on the sled, and the other end rests on the logs on the skidway. A long chain is fastened to the sled and passed over the nearest log. The horses are hitched to the other end of the chain on the other side of the sled. They pull the chain, and the chain brings the log across the skids to the top of the other logs upon the sled. Other logs are drawn up, in the same way, till the second tier is full. Then longer skids are used. The horses draw the logs, with the chain, in the same way. They do this until the sled is piled high with logs.

"Sometimes, when the sleighing is good and the teams are very strong, as many as one hundred logs are piled on the sled, and drawn in one load. Generally, a load contains from fifteen to thirty logs.

"The sleds are driven to the lake or river, and unloaded on the ice."

XII. GOING DOWN THE RIVER

"Then a man comes and looks at every log. This man is a 'scaler.' He can tell how much lumber each log will make; that is, how many square feet of inch boards can be sawed from it.

"He has a rule with which he measures every log. On the rule are printed figures which show how many feet of lumber there are in a log of certain dimensions. But the log may be crooked or rotten. Then the scaler must use his judgment as well as the rule.

"While the logs are lying on the ice, the name or mark of the owner is stamped into them with an iron stamp hammer.

"When the ice breaks up in the spring the logs fall into the water. The current carries them down stream. Sometimes they float hundreds of miles, to reach the sawmills, where they are made into lumber.

"Men follow the logs, sometimes walking along the shore, sometimes going in boats.

"The current of the river takes most of the logs

down stream; but some are left in boggy places, or are caught by points of land, or by rocks or sand bars, while others lodge in shallow water.

"The men use long poles to turn the logs into the stream again. They often go out on the logs



Logs in the River.

in the water. They have sharp spikes in their shoes to keep them from falling; but sometimes the logs turn and throw them into the water. The river takes the logs to the 'log jam.'

"The log jam may be several miles in length.

The logs are heaped in great confusion. The river brings the logs, from the camps, together into one great log jam.

"The men climb on the loose logs and with cant hooks roll each log, till they find the owner's mark. This is called 'log rolling.'

"When the owner's mark is found, the log is driven into the boom.

"The booms are trails in the water, fenced by floating logs, which are chained together at the ends.

"The logs which fence the booms are very long: some thirty, some sixty, or even eighty, feet long. The ends are lapped and chained. Holes are bored in the ends of the logs. The chain is put through and fastened with a link and toggle."

"What is a toggle, Papa?" asked Walter.

"A 'toggle,'" said his father, "is a bar of iron shaped like the gold bar at the end of my watch chain, and attached to the end of the chain in the same way. I slip this gold bar through my button-hole, but the toggle is slipped through a link in the chain.

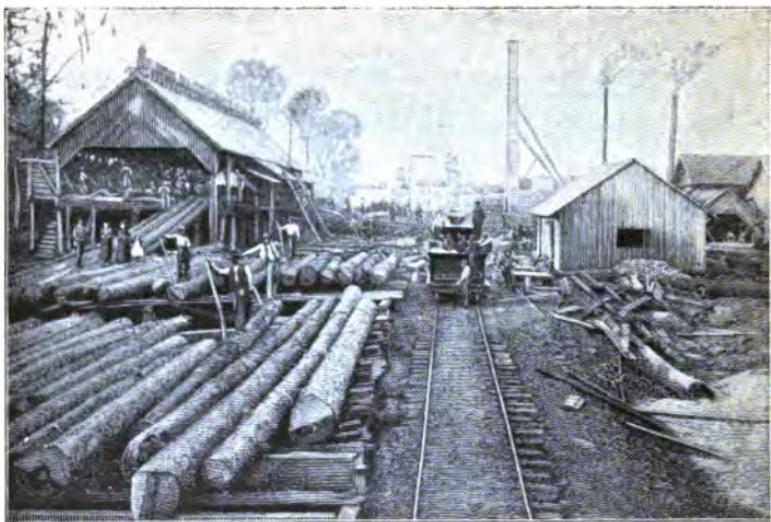
"The logs are taken through the booms to the first 'sorting gap.'

"In the sorting gap they are looked over carefully. The mark of each log is noted. Those

marked with the name of the owners of the nearest mills are turned into the booms that lead to those mills. The other logs are left in the first booms to be carried to the next sorting gap.

"There the marks are read again. More logs are taken out for the nearest mills.

"At the last sorting gap all the logs belong to two or three mills. So the marks are now easily found, and the logs are turned into the side booms for the last mills on the river."



Sawmills.

XIII. AT THE SAWMILLS

"When the logs reach the mills they lie in the water until the mill is ready for them.

"Then they are drawn up out of the water into the mill by strong chains, and swiftly-moving saws divide them into boards or timbers. Now they are lumber.

"Again the teamsters come with heavy wagons and strong horses. They draw the boards away to the great lumber yards, where they are piled and stay until they are 'seasoned' — which means dry enough to be used. Some of them are loaded on freight cars and brought to our village. They are

piled in our little lumber yard, and there we buy what we need.

"When the logs are sawed, there are boards, dimension lumber, slabs, or pieces too rough or too small for sale, and sawdust. Some of the larger pieces are cut into lath or shingles. The rest is taken to the wood yard and used for fuel by the people who live near the mills.

"Most of the sawdust is used for fuel in the furnaces that make the steam to keep the machinery of the sawmills in motion. The sawdust is put into the furnace, without being dried at all; but it burns well, and makes a very hot fire. A good deal of sawdust is used for packing ice in ice houses.

"There are dark clouds in the west. If it is too wet to work in the corn to-morrow, we will lay the stable floor.

"Early in the morning you may drive old Tom to the hardware store, to get the nails."

XIV. TOM

Tom is the oldest horse on the farm. He does but little work; he is too old. Walter says Tom has too much time to think.

One morning Grandpa King harnessed Tom, to go to the village and get the mail. Walter was going too.

It was a very warm morning, and Tom did not want to go; so he limped badly.

"Poor old Tom!" said Grandpa, "I did not know you were lame. You shall go to the pasture, and Walter and I will walk."

He turned Tom's head toward home. Tom was no longer lame, but trotted off briskly. Grandpa King laughed. "No, Tom," said he, "Walter and I will not walk. You can take us to the post office."

In summer Tom spends most of his time in the pasture. Last summer Mr. King often found the young horses in the cornfield. Tom always stayed in the pasture.

Mr. King thought Tom was a very well-behaved

horse to stay in the pasture when the bars were down, but he wondered how it happened that the bars were so often down.

One day he saw the horses eating grass in the pasture. Tom stood alone by the bars. Mr. King



Tom lifting the Bars.

stood in the shade of a tree and watched. Tom took the top bar in his teeth and let down one end. Then he took the second bar and let it down the same way, and so on until they were all down. Then he walked back to the rest of the horses, and began to eat grass. The young horses ran out into the corn.

Mr. King drove the horses back, and fastened the bars so that Tom could not slip them out.

He says Tom laughed when he came into the stable that night.



XV. NAILS

Walter harnessed Tom to the buckboard. The buckboard was a very light wagon. Mr. King said they should need spikes in laying the stable floor, and John said the shingle nails were all gone, and there were only a few fourpenny and sixpenny nails left.

Walter's father told him to get a pound of each of these kinds of nails, and three pounds of spikes. Spikes are very large nails.

Tom limped a little when Walter turned his head toward the village. Walter jumped down and gave him a big lump of sugar. That made him feel better; so he pricked up his ears, trotted away, and they soon came back with the nails.

"Papa," said Walter, "I know why shingle nails are called shingle nails; but I do not see why such odd names are given to the others as 'fourpenny' and 'sixpenny' nails."

"Nails are named from their use," said Mr. King, "and from their weight. Shingle nails are also known as 'twopenny' nails. That means a thou-

sand of them weigh about two pounds. By 'fourpenny' or 'sixpenny' or 'tenpenny' nails, we mean that a thousand of each kind weigh about four or six or ten pounds.

"The word 'penny' here means 'pound.' These names were applied to nails in England. The English workmen called them 'two-pun' 'four-pun' and 'ten-pun' nails. Then other people began to speak of them as 'twopenny' and 'tenpenny' nails."

"How are nails made, Papa?" asked Walter.

"Almost all nails are now made by machines," said Mr. King, "from rods and bars of iron called 'nail rods.'

"Nail rods are made by rolling iron into rods or wire, or by cutting little bars from plate iron with rolling shears, which sometimes cut ten miles of nail rods in an hour.

"Nail rods are heated and fed to the nail-making machine, somewhat as we feed straw to the straw-cutter.

"A sharp knife shuts down on the rods. The knife is called a 'slicer.' It cuts the nail rods into pieces as long as the nail wanted.

"These pieces are called 'nail blanks.' They are caught as they fall from the 'slicer,' and are held firmly by the 'neck.' A die or stamp strikes them with force enough to form the head.

"From one hundred to one thousand nails are made in an hour by this machine.

"Horseshoe nails are now the only nails made by hand, and even many of these are made by machine. The best horseshoe nails are those made by hand, because iron can be made tough and even in quality by hammering. If they were not tough and of the same quality in every place, they might split, and splinters of iron might get into the horse's hoof. They are made of the best iron, and are hammered to a point.

"French wire nails are sharpened by blows from a hammer. The 'neck' is held in a vise, and the head is made by beating.

"The vise makes four little grooves near the head of the nail. These grooves help to keep the nail in its place, after it has been driven into the wood; but wire nails do not hold so fast as cut nails, because they are too smooth.

"Now the men have taken up all the boards, and cleared away the rubbish. The joists, or the timbers on which we nail the planks, are in good order. We can lay the floor at once."

The men brought in the heavy planks. Two men laid them side by side. Two more drove the big spikes, and the new floor was finished before it was time for Walter and Ben to bring home the cows.

XVI. MAMMA TOAD AND HER BABIES

There was a big mother toad in the pansy bed. Walter had seen her there all the spring. He often

watched her as she sat waiting for insects; for he liked to see her tongue dart out when flies came near.



The Toad.

After a while he noticed that the toad sat almost all the time in a little hole on one side of the pansy bed. He saw, too, that every morning, when she went away, she covered the hole so as to make it look as smooth as if there had been nothing there. She used her fore feet to fill the place with earth.

Walter told his mamma what the toad did, and asked her why she hid that hole; and his mother said the next time the toad went away they would see what it was she covered so carefully.

The next morning Walter ran into the house to say that the toad was gone.

His mother took a little wooden spade, and dug out the earth very carefully. There, in the hole, hidden by the warm earth, were seven little baby toads.

Mrs. King put the soft earth back, as she had found it. Walter took care that nothing disturbed the mother toad and her babies, until the little ones hopped away, to look out for themselves.

One day Walter found Mrs. Toad under the rosebush. She had been plump and brown and warty. Now her skin seemed too large for her, and there was a yellowish streak down her back. She raised one arm and then the other. She shrugged her shoulders, and rubbed her breast with her hands. The strokes were always down. Soon the loose skin parted at the yellow streak. Mrs. Toad kept up the strange movements with her hands and arms and shoulders. The skin came off. She rolled it into a little hard ball, and swallowed the ball.

Walter said she acted like a man putting on his overcoat, but Mrs. Toad took hers off.

XVII. THE STORY OF FLAX

"Grandma," said Walter, one rainy day, "you promised to tell us a story about that field of blue flowers. Will you please tell it to-day?"

"Oh, about the flax blossoms," said Grandma. "Yes, sit down, and I will tell you the story as my grandmother told it to me when I was a little girl.

"Once there was a shepherd who had large flocks of sheep and goats. One morning in early spring he led his flocks out to pasture in the mountains. He said he should be home at sunset; but when darkness fell he had not come. The children were restless, and the little ones were fretful, because they wanted their supper of warm goat's milk. Their mother soothed them, and told them that their father had only gone a little higher up than usual, and would soon come home.

"But he did not come that night, or the next, or the next.

"Two goats found their way back to the cottage, and their milk kept the little children from starving.

"The shepherd had been a skillful hunter, and his house was well supplied with warm fur rugs. These the mother sold to buy food and fuel when the north wind began to blow. No news came from the dear lost father all through the winter. They thought some wild animal had torn him in pieces, or perhaps an avalanche, as it swept down the mountain side, had crushed him beneath its weight of snow and stone.

"But with early spring he came home alone. His sheep and goats were gone, his clothes were worn, his face was thin and pale. In one hand he carried a bunch of blue flowers, and in the other a measure of little brown seeds.

"After the first joy of meeting, his wife was more sorrowful than ever; for she thought her husband had lost his mind as well as their means of livelihood.

"But he was cheerful and happy, and seemed full of hope, as he showed the children the pretty flowers and told their mother about the gift of the seed.

"All these things happened many hundred years ago, when people believed in fairies and in gods and goddesses.

"The day the shepherd left home he saw a fine chamois on a crag not far above his head. Its

horns glittered in the sunlight, as it leaped from rock to rock. He took his crossbow and started in pursuit. The beautiful creature was always in sight, and always beyond the reach of the arrows. It led



The Shepherd and the Goddess.

him on until he came to a great glacier, when it disappeared.

"There was an opening in the glacier, and within the opening, was a light. The shepherd went in boldly, and found a crystal palace within the icy walls. The ceilings were thickly studded with garnets. Beyond he could see beautiful

groves and meadows. A tall woman stood in the hall. She was clad in silvery garments clasped at the waist with a golden belt. She held in her hand a cluster of flowers as blue as her own eyes. On her abundant fair hair rested a crown of carbuncles. She was surrounded by beautiful maidens, whose heads were crowned with Alpine roses. The shepherd knelt before the queenly woman.

“She spoke to him kindly and asked him to choose for himself the best of all her treasures. He begged the bunch of flowers in her hand. She seemed pleased at his choice, and said, as she gave them to him: ‘You will live and prosper until these flowers fade. Here is a measure of seed. Sow it on your own land, and you will have many such flowers as these.’

“He was about to kiss her hand, when a peal of thunder shook the mountain and the palace was gone.

“Only the rocks and the glacier remained; but he still held in his hand the beautiful blue flowers; and the measure of seed was by his side. He took up the seed and the crossbow, and went back to look after his flocks. He could not find them. Bears and wolves had eaten them all, except a few fleet-footed goats. He had been a whole year in the mountains, while he thought he had spent only a few

hours chamois hunting. But he had the bright blue flowers and the measure of seed.

"The children smiled when they heard the shepherd's story, but their mother's eyes filled with tears, and she touched her forehead to show that she now felt sure that her husband's mind was wandering.

"The next day the shepherd plowed a field and sowed the seed. There was still seed in the measure. He plowed and sowed another field; and seed still remained. He plowed a third field, and had seed enough to sow it.



Flax.

"Soon the little green shoots appeared. The shepherd watched his fields day and night. When the little blue flowers unfolded, the fields were so beautiful that even the unhappy wife rejoiced at the sight. Once while she was helping tend the flowers, she saw the lady of the mountain walking through the fields and blessing them. The shepherd's wife immediately recognized the beautiful lady as the kind goddess, Holda, and, while her face shone with joy, her heart was filled with thanksgiving.

"When the flowers had faded and the seed had ripened, the goddess came again and showed the

shepherd how to prepare the flax. Then she went into the cottage, and told the wife how to spin and weave the thread, and how to bleach the linen.



Spinning.

"The shepherd and his wife gave seed to their neighbors, and taught them to cultivate flax. They grew rich, and gave employment to thousands of people, paying them generous wages. They lived to see their children, grandchildren, and great-grand-

children gathered happily around them. After many happy years the bunch of blue flowers began to wither, and the shepherd knew that his work was finished.

"A few days later he again saw the crystal palace in the mountain, and the light beyond. He entered the door fearlessly, it closed behind him, and he was Holda's guest forever.

"But the children cultivated the flax, and sent the seed to other countries, until it was known in all parts of the world.

"When Columbus discovered the New World, the little brown seeds were brought over in ships, and the beautiful blue flax was grown in America. Other uses were found out, and now whole fields of flax are grown in our country for the seed alone. The seed is crushed in mills; the oil is taken out to use in mixing paint; what is left, called 'oil meal,' is fed to cattle and sheep. But in the old country the flax fiber is spun and woven into the finest linens and most delicate laces."

XVIII. THE CATBIRD

In July Walter's cousin Henry came to spend a month on the farm. Like many older folks, Henry thought he could not enjoy a vacation without causing pain to some innocent creature. His father shot deer; his big brother caught, just for sport, more fish than he could use and Henry put his "sling shot" in his pocket to kill chipmunks, gophers, and birds.



The first morning after his arrival he went into the garden where Hilda was picking currants. He heard a bird singing. He thought it was a bluebird at first, then it seemed to be a robin, and then he could not tell what it was; but it sang the clearest, sweetest, most beautiful song he had ever heard. The beautiful song, however, changed to the cry of an angry cat, when Hilda came near the apple tree.

The Catbird.

"What's that?" asked Henry.

"That's a catbird," answered Hilda. "Here he is in this apple tree. He is scolding me for taking his currants."

In an instant Henry had drawn his "sling shot" and sent a smooth pebble straight to the head of the little songster. He fell at Hilda's feet.

"What's all this?" called Mr. King, who was driving up to the gate. "Don't you know that boys with sling shots, and men with shotguns are never allowed on this farm?"

"It was only a catbird, Uncle," said Henry. "It was stealing your currants; and its wings will just match my sister's new slate-colored dress."

"Never mind your sister's dress," said Mr. King, coming into the garden. "I want to prove to you, Henry, that this little bird has earned all the fruit he has ever taken." He thereupon took out his knife, intending to show how many insects the poor little crop contained; but a slight quiver in the gray feathers showed that the bird was only stunned, and Mr. King laid him down under a currant bush on a bed of leaves.

"But, Uncle," said Henry, "birds do eat fruit and grain."

"Yes," said Mr. King, "and we must raise enough for them too. They ought to have their share first,

because all the spring they have lived on worms and insects that would have destroyed fruit and grain and every green thing. We are indebted to the birds for everything that grows on the farm."

Then the bird moved a little, and Mr. King said : " Now we must go away, so as not to frighten him when he wakes up. I hope all the catbird family will be able to scold Hilda to-morrow morning."

XIX. THE PARTRIDGES

On the Fourth of July Walter and Henry roused the family at daybreak with their firecrackers. The men attended to the work at the barn, and turned the cattle out to pasture, while Hilda prepared an early breakfast, that all might enjoy a long holiday. Then the lunch baskets were packed and stowed away in the big carriage; the two boys led out the horses; and the whole family drove away to spend the day at the lake.

The little children waded in the shallow water, while the older ones swam or rowed or fished. Henry caught two black bass, which Hilda broiled for dinner, and all agreed that they had never tasted such good fish.

In the afternoon Mr. Stevens rode out to the picnic grounds. Mr. Stevens was an old friend of the Kings, and a teacher in a city school. He wanted some pitcher plants for his botany class. Mrs. King said she and Walter had often found them in the swamp on the other side of the lake, and Walter offered to show him where they grew.

So they rowed across the lake, and found the plants in bloom. The dark red flowers guided them to the pitchers hidden in the grass.

The pitchers are the broad leaves of the plant, joined at the edges to form cups. They are sometimes called "bear cups." They are filled by the



The Partridge.

rain, and hold water; so that in times of drought birds and small animals can drink from them.

When they had gathered as many plants as Mr. Stevens wanted, they started to go back to their boat. Suddenly there was a whir; and a partridge, with wings extended, ran across the path. A brood of little ones followed the mother bird. They kept up very well, but one of the weakest fell behind. It

stopped at Walter's feet, and hid its head under a leaf. It seemed to feel perfectly safe, although its whole body was in plain sight.

Mr. Stevens picked it up, and said, as he examined its pretty mottled down: "What a treasure for our museum! I never saw a baby partridge before."

But Walter begged so hard for the life and freedom of the little bird that the kind-hearted teacher put it down, and it scampered off after its mother.

On their return Mr. Stevens told of the adventure, and Mr. King said: "After all, Walter, I am not sure that you did the kindest thing for the little bird. Mr. Stevens would have taken its life, but he would have done it as gently as possible; and when mounted it would have been very interesting to his pupils. Now it probably will be shot by some thoughtless sportsman, perhaps killed, and perhaps wounded, and left to die a lingering death in the woods."

"Hark!" said Mr. Stevens, "what is that?" as a sound somewhat like the roll of a snare drum came across the water.

"That is the drumming of a partridge," said Mr. King. "The male bird stands erect on a log or rock, spreads his wings, and brings them down twice, making a noise like the tap of a drum. After a second's pause, he moves his wings rapidly for a

minute or two, making the drumming sound that we often hear. He seems to do it by the quick motion of his wings in the air, rather than by striking the log. It is very seldom possible to find a partridge in the act of drumming; for he stops at the least disturbance, although he seems to be as fond of making music as boys are on the Fourth of July."

"He is celebrating the Fourth of July too, isn't he, Uncle?" said Henry.

XX. HAYING

"To-morrow we shall begin haying," said Mr. King.

"May Henry and I help?" asked Walter.

"We can rake, of course," said Henry.

Mr. King laughed as he answered, "Forty years ago you might have raked, but we can hardly trust you to do it now."

"Yes," said Grandpa King, "forty years ago, boys like you could help in the hayfield, and in harvest too. Then we cut the hay with scythes. Five or six men, cutting wide swaths with their sharp scythes, made a pretty sight."

"What is a swath?" asked Henry.

"It is a strip of grass or grain, cut by a scythe or cradle," said Grandpa King. "We generally had six men to mow the grass. One man started in; and just behind him, about four feet to his right, came the second man; and so on, until all six were at work."

"When the cut grass had dried a little, we turned it with pitchforks. After a few hours we raked it

with hand rakes into heaps, which we called hay-cocks. You will see the same thing done by the tedder and horserake to-morrow, if it is a pleasant day. Then we loaded it on wagons, and drew it to the barns or stacks, where the boys, and girls too, could help mow away and tread down the hay."

"Yes," said Mr. King, "I well remember those loads of hay though I do not remember the mowing and raking. You had a mower and a horserake before I was old enough to go into the field. But I think the boys will have some fun if we do use a mower and a tedder and a horserake in the field, and a hayfork for unloading."

The next morning the boys were out early, watching the sharp knives of the mower sickle clip off the tall grass. James was on the driver's seat; the horses were losing their nervousness at the clatter of the machinery; and all was going well, when James stopped the horses and called, "Look, Walter, there's a chicken fluttering in the grass."

Walter ran and caught the fluttering creature.



Cutting Hay with
Scythes.

It was not a chicken, as James had supposed, but a young crow, whose wing had been hurt.

"Take it to the house, Walter, and let Grandma doctor it for you," said Mr. King.



Hay Harvest.

Walter carried it to Grandma King, and hurried back to the meadow. The sunshine was bright and hot, and Henry was resting in the shade.

"That will never do for a farmer," thought Walter; "I must learn to stand the heat." So he brought the men fresh water from the spring, and

watched his father while he put the tedder in order.

The tedder had two wheels, and was drawn by two horses. There were three forks fastened to each side; so that when the wheels revolved, the forks tossed the hay in all directions to dry it more quickly. It was needed only when the grass was thick and heavy, or very wet.

"May I drive the tedder?" asked Walter.

"Yes," said Mr. King, "to-morrow morning you may hitch old Tom and Jack to the tedder, and turn the grass."

The next morning Walter drove the tedder for an hour, and did his first real work in the hayfield.

In the afternoon Mr. King harnessed Daisy to the rake, and drove into the field. Daisy was a young horse, and had drawn only a light, two-wheeled carriage, called a sulky. At first she seemed to think she was drawing a



Raking—New Style.

sulky, and liked it very much; but when Mr. King let down the long teeth of the rake, which began to gather up the hay, she knew she was beginning to work on the farm. She did not want to be a farm

horse; so she stopped and stood on her hind feet for a long time. Mr. King talked to her; and when she became quiet, Walter patted her nose, and gave her lumps of sugar. After a little she went on and raked the hay very well indeed.



In the Hayfield.

There was no rain that night; and when the sun had dried the dew the next morning, John harnessed Prince and Billy to the farm wagon. The box had been taken off, and the hayrack put on. Walter and Henry climbed in, and John drove to the hay-

field. He stopped beside a haycock, and James threw the hay upon the rack with a pitchfork. John put it in place and drove on.

The boys tumbled on the hay, and threw it over each other, and laughed so much that John said they would make the horses run away. Then Walter laughed harder than ever to think how those big clumsy draft horses would look running away, and Henry rolled off the load. But he fell on a haycock, so it did not hurt him.

When the rack was piled high with hay, they drove to the barn. The boys went into the haymow; the big hayfork was shoved deep into the hay on the rack; old Jack was hitched to the rope attached to the hayfork. When he pulled the rope, it filled the fork and took about a sixth of the load into the haymow. Walter and Henry helped the men pack it away, and said that this was the best fun of all.

XXI. NED

The wounded crow recovered rapidly under Grandma King's treatment. One day she set him on the gatepost, and told him he was well enough to live in the woods. But he only flew about a little while, and came back to the house. So he became one of the household pets, and Walter named him Ned.



Ned.

Everybody liked Ned, although he was mischievous and noisy. Mrs. King said he forced the children to be orderly, because he was sure to carry off any small thing that happened to be left in his way.

One day little Edith was very ill. The doctor said she must not be disturbed by any noise; and he looked at Ned perched on the mantel. Mrs. King called Walter to take the bird to the barn.

Walter shut him in the stable with Tom, but Ned managed to get out, and was already in Edith's room when Walter came back.

Ned had alighted on the bed, and was taking Edith's little hot fingers one by one in his horny beak. He said "Caw, caw" all the time, but he said it in a whisper. The little girl opened her eyes and smiled. After that Ned was allowed to stay with her.

XXII. TOM AND BEN

Ben is a big black Newfoundland dog. He is very fond of Walter, and goes all over the farm with him. Mrs. King says she is not afraid to let the children go anywhere with Ben.

One very hot day Mr. King asked Walter to go to the pasture to see whether the horses had water.

There is a well in the pasture, and a long trough near the well. The men pump water into the trough for the horses to drink. Sometimes they forget to do it; then the horses get very thirsty.

When Walter and Ben came within sight of the pasture, all the horses were standing by the trough. They seemed to be talking to Tom, and Walter thought they must be asking him to pump water for them. Tom held his head very high, and looked first at the pump and then at the empty trough. He seemed to feel sorry for the thirsty colts. He took the handle of the pump between his teeth, and moved it up and down, till the water came, and the colts drank it.

"Good old Tom," said Walter, "I will pump some for you."

"What ails your shoulder, Tom?" asked Walter.

A wasp had stung Tom's shoulder. It was much swollen, and very painful. Walter wet his handkerchief and held it over the swollen place.

Ben stepped up to Tom's side and licked the place. He could reach it easily.

Tom seemed to like Ben's soft tongue better than the wet handkerchief. Ben licked Tom's shoulder many times every day until the wound was cured.

Tom had never liked Ben, because, when he was a young horse, he had learned to dislike all dogs. But when Ben licked his shoulder, and took care of it so faithfully, he became very fond of him. After that he let Ben take the end of the halter, and lead him out to water and back to the stable.

Ben was very happy with his new friend.

XXIII. HARVESTING

Early in August the oats were ripe, and the wheat fields were beginning to look white. The heads of grain hung down with the weight of the ripening kernels. Morning and evening the quail piped, "More wheat, more wheat," and Mr. King, who liked to have the flocks of quail in his fields, said they were welcome to all the wheat they wanted.

Walter drove Tom to the village to get the binding twine.

"What is all this string for?" he asked, when John was taking it out of the wagon.

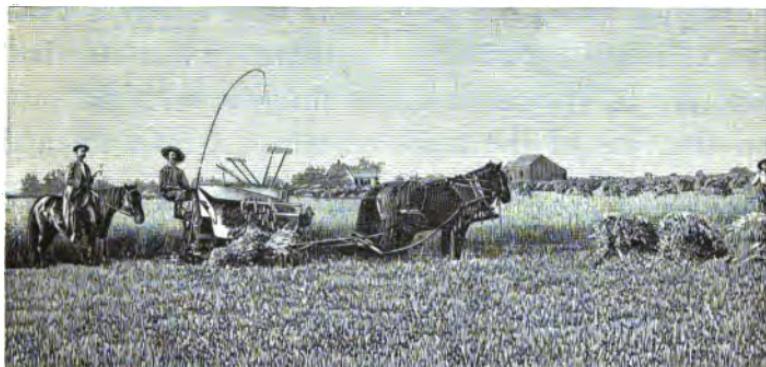
"To tie up the bundles of grain," said John, "as you will see to-morrow."

But Walter could not wait until the next day, so he asked Grandpa King about harvesting.

"When my father was young," said Grandpa King, "and that must have been about eighty years ago, he used a sickle to cut grain. Yes, Walter, the same kind of sickle that we use now to trim the lawn grass about the trees and shrubbery. It was

slow, hard work, and but little progress could be made in a day.

"When I was old enough to go into the harvest field, we had cradles. A cradle is a scythe, to



Harvesting Oats.

which is added a framework of long fingers made of wood, very tough and elastic. This framework caught the grain as it fell and laid it in even swaths, so that it could be more easily raked and bound.

"It was all raked by hand rakes. When enough grain had been gathered to make a bundle, a band was made by twisting together wisps of grain, and the bundle was bound with it. Then we set the bundles up in shocks or stooks, as we do now.

"But we lost much grain even in small fields, for the grain ripened faster than we could take care of it, and the highest wages often failed to secure men

enough to save the crop. I had the first reaper in the neighborhood."

"I remember it," said Walter's father.

"It was a clumsy affair," said Grandpa King, "compared with the binders we have nowadays, but it was much better than anything we had ever had before. It cut the grain and threw it on a platform on the rear of the machine, where a man sat and raked it off, when enough had been cut to form a bundle. That left the bundles on the ground for the men to bind in the old way. A great many men were required to keep up with one reaper.

"Then we had a reaper that threw the cut grain upon a table on the rear platform, where two men bound the bundles, and threw them off on the ground. Next we had a binder that cut the grain, and left it in bundles bound with wire. But the wire caught in the thrashing machine, and the pieces, left in the straw, sometimes hurt the cattle. Now we have the twine binder, which you will see to-morrow."

In the morning John drew the binder out from the shed, put on the reel and the canvas "aprons," that had been taken off for winter, looked over all parts carefully, and oiled the machinery, ready to start. Then he hitched on the horses, and drove to the harvest field.

The sharp knives of the sickle cut the grain, as the mower cut the grass; but instead of leaving it on the ground, the reel caught it, and threw the heads back against a sheet of canvas, which kept the grain straight and even, on the platform, behind the sickle. A canvas apron on the platform carried the grain up to the "elevator," which took it to the binder.

Then Walter found the twine. It was in a box at the rear of the elevator. One end was brought up and threaded into the eye of a big needle. As the grain passed along, it fell into the binder, where it was pressed together in a bundle, and then tied by the needle. A little knife clipped the twine, and two strong iron arms threw it out on the bundle carrier. When the bundle carrier held several bundles (three or five), the driver lifted a lever with his foot, and threw the bundles off on the ground.

As the binder passed round the standing grain, it threw off bundles at about the same intervals; so that when the grain was all cut, there were windrows of bundles across the field. The men set them up in shocks to dry.

XXIV. STACKING AND THRASHING

When the shocks of grain had stood in the field about ten days, the horses were again harnessed to a wagon with a hayrack. Walter rode on the rack as before; but this time he helped to lay the bundles in rows, instead of tumbling among them as he did in the hay.

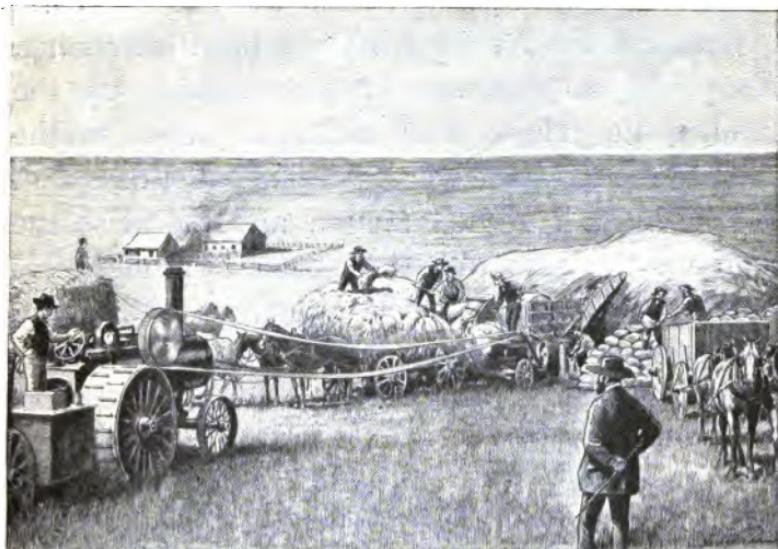
When the load was finished, they drove to the place where the stacks were to be made. The bundles were pitched off on the ground; the first ones were set up in a shock, to form the center of the stack; the others were laid in circles round it, on the smooth, hard ground, with the heads toward the center, and a little higher than the butts (the straw ends of the bundles).

The stack grew smaller as it was built up, until, when finished, it was cone-shaped. This was to make the stack shed water.

When the grain had lain in the stacks a few weeks, the steam thrasher came puffing and blowing into the yard. The separator, the part of the machine that takes the wheat out of the straw and

chaff, was set up between the stacks. The engine was placed in front of the separator, and connected with it by a long and very heavy belt.

Some men climbed to the top of a stack; other men took their places about the machine; and



Thrashing Wheat.

the engineer turned on the steam. The men on the stack pitched bundles down into the feeder. The big iron cylinder, with savage-looking teeth, tore the bundles to pieces, and carried them to the sieves within the separator. There was a great noise, a rumbling and whistling and shaking and rattling, and the straw passed on to the straw pile, to be

taken care of by men who stacked it; while the wheat poured out of a spout, at the side of the separator, into a bag hung there to catch it. A man took off the full bag, and put an empty one in its place, and the bags were tied and piled on a wagon that stood near, and were driven away to the barn.

Walter could not tell what was most interesting, the puffing engine, the separator eating up the bundles, the yellow straw falling in heaps on the stack, or the stream of wheat pouring out of the spout. But he liked it all, the motion and the noise, the chaff and the dust. When he came in at night, his mother said, "Walter is as dusty as a thrasher, and too tired to ask questions."

XXV. SEPTEMBER

After the thrashers had gone Walter helped the men clean up the scattered wheat and put the yard in order.

"What are you going to do with all this wheat, Papa?" he asked.

"We must let it stay in the granary until we have cut the corn, and then we shall take it to the first station on its long journey," said Mr. King. "Now we must get the corn binder ready for an early start, Monday morning."

"Then I must go to school," said Walter, "and I do want to help with the corn."

"Well, so you may," said his father. "There will be at least an hour after school every afternoon, and all day Saturday."

Monday afternoon Walter came home from school and changed himself quickly from a little student into a little farmer. He put on his blue "overalls" and "jumper" and ran to the cornfield.

The corn binder was at work. It had two wheels, and was drawn by two horses like the mower and



grain binder. Its strong, sharp knives cut big corn stalks as easily as the mower sickle cut the grass. The needle, threaded with twine, bound them securely; and a pair of big iron arms tossed them to the bundle carrier. When the bundle carrier was full, the driver raised a lever, which threw them on the ground.

The men set them up in shocks, as they had set up the bundles of wheat; only they used a wooden "horse" to hold the cornstalks.

They made the "horse" by fastening two legs to a long board, and passing a stick through a hole in the board, to make a support for the first bundles, while the others were being placed around them. When the shock was large enough, the "horse" was drawn out, to be used again.

While the corn was drying in the shocks, the apples turned red and golden in the orchard, and clusters of purple grapes peeped out from the broad green leaves. Walter had been so busy watch-

Corn.

ing the ripening grain and fruit and all the work of the farm, that he almost forgot the children's garden, where they had planted pop corn in the spring. Indeed Edith and Robert had taken most of the care of it all summer; and one day Edith asked, "Will the binder cut our corn, too?"

"I think," said Grandpa King, "that Walter and I shall have to cut your corn with old-fashioned corn knives, and bind it with pigeon grass."

"There isn't any pigeon grass, Grandpa," said Robert, "for we have kept the weeds all out."

"That's right," said Grandpa, "we will bind it with the small stalks, and next month we will have a husking bee."

So Walter brought the old corn knives, with straight wooden handles, and soon there were four stooks of pop corn drying in the sun.

XXVI. CORN HUSKING

The September frosts had nipped the trees enough to remind them that it was time to get ready for winter, and the trees had changed their green summer dresses for the many-colored robes of autumn, so that the October sunshine found them gay with their short-lived finery.

Walter had been reading about the husking frolics of New England in the good old days, and was somewhat disappointed to find that his father always used a "husker and shredder" to save his corn.

"I think you will like the new way best," said Mr. King; "but you will soon know which you prefer, for your mother has invited a dozen of your friends to husk pop corn next Saturday."

The husker was set up in the stackyard; a small engine was placed near, and connected with it by a long heavy belt, like the belt of the steam thrasher. James drove in from the field with a load of corn bundles. The engine shrieked and the machinery was set in motion. James pitched a big bundle down

on the platform beside the husker. One man cut the band and passed the stalks along to another, who fed them to the machine, which bit them hard and broke them into little pieces. The yellow ears came out at one side, while the shredded stalks and husks were carried to the place where the stacks were to be made, and the kernels that were taken off by the rough handling were thrown on a sieve, and saved in a bag fastened to the spout leading from the sieve.

"You see, Walter," said Mr. King, "that the corn is all saved in good condition, and the cattle like these stalks much better than they did the stalks that were stacked in the old way."

When the husked corn was put away in the corn house, Walter asked, "Why isn't the corn house boarded up like the barn?"

"The corn would heat and spoil if it were kept from the air," said his father; "so we leave a space of about three quarters of an inch between the boards when we build a corn house."

Saturday afternoon was as bright and warm as October sunshine could make it. The little guests came early in clothes suitable for farm work, as Mrs. King had requested. The girls had gingham aprons, and the boys brought overalls.

The pop corn was well dried. Walter took down

the stooks, and cut the bands. Grandpa King husked with the children, and told stories of husking days when he was a boy. At sunset the work was all done, and there was time for games before supper.



Husking Corn.

"Now you know what corn huskers had to endure," said Grandpa King. "We have had a pleasant day; but if we had a whole field to husk, we should be obliged to work among damp stalks on frosty mornings, and snow might fall before we could finish."

"I shall have a machine to do the husking on my farm," said Walter.

"What is pop corn?" asked one of the little visitors; "I mean, what makes it pop?"

Grandma King had bowls of warm water, and soft towels ready for the soiled hands, and strips of old linen for the roughened and cut fingers.

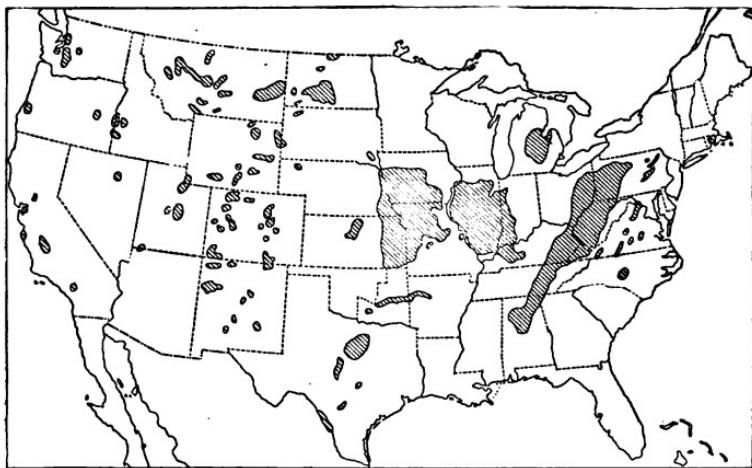
"I didn't know we were hurting our hands so much," said Walter.

"It is a variety of Indian corn," said Grandpa King; "but it contains more oil than the larger kinds of corn, and when the oil expands by heat, the kernel bursts, and the starchy part is changed



Popping Corn.

into the cream-white substance we all like so well. We'll try it this evening, for I have a few ears dry enough to pop, and Grandma has a coal fire ready for us in her grate."



Coal Fields in United States.

XXVII. ABOUT COAL

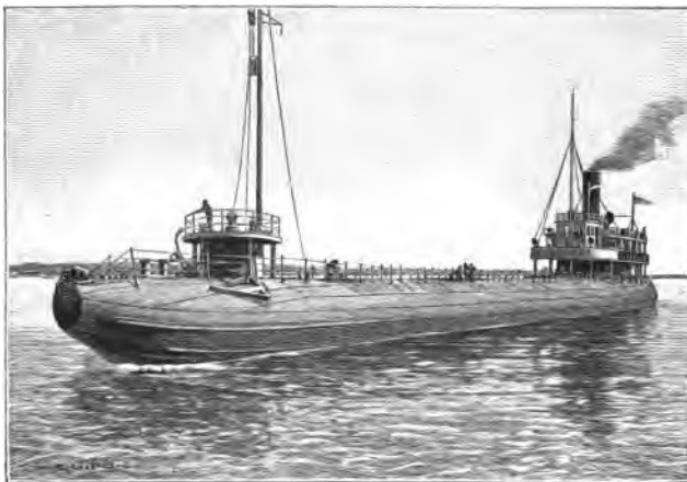
After the little corn huskers had gone, Walter lay on the rug, looking at the coals in the grate. At last he said, "Where does coal come from, Papa?"

"Most of ours comes from Pennsylvania," said Mr. King. "The lake vessels that carry away our wheat and iron ore bring back coal."

"Yes," said Walter, "I saw the steamers and coal docks at Duluth last year. I should like to know something about coal itself."

"Well," said his father, "I'll try to tell you what I know about coal and what I remember about a coal mine I saw some years ago.

" You have seen the four kinds of coal, anthracite bituminous, lignite, and cannel. You know that we use anthracite coal for heating houses, because it is cleaner and more pleasant to handle ; and bituminous, or soft coal on blacksmith's forges, because it burns with a flame, and ' packs ' about the iron. That means that, as it burns, it falls into small pieces, which settle closely about the iron. We sometimes burn lignite or brown coal in the grate, and it still shows traces of the wood from which it was formed."



Steamer carrying Coal.

" Why, Papa, do they make coal from wood ? " asked Walter.

" No, only charcoal," said Mr. King.

" Cannel coal is used chiefly in grates. It was

first found in England, and was called ‘candle coal,’ because its bright flame gave so much light; but the people said ‘cannel’ instead of ‘candle,’ and the name has clung to it ever since. One variety of cannel coal can be cut and polished. It is called ‘jet,’ and is made into beads and ornaments.

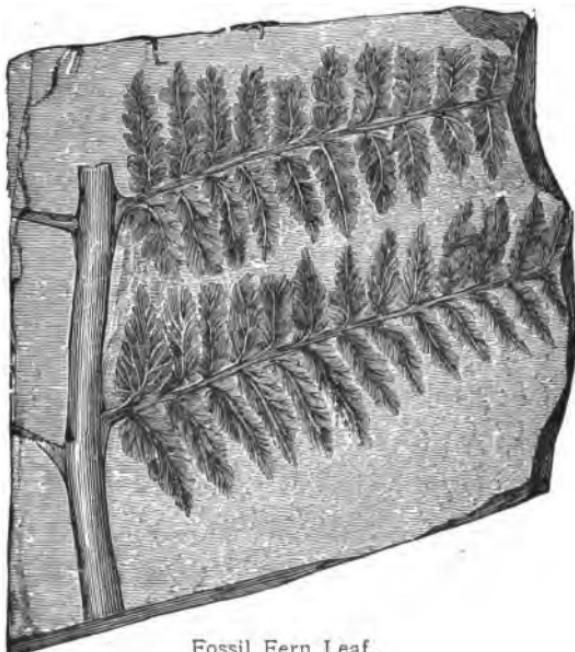
“Charcoal is made directly from wood, which is covered in ‘charcoal pits,’ and burned very slowly, smothered with but little air. Everything else in the wood but charcoal is boiled out. Charcoal burning is now rarely done. Wood is now distilled for wood alcohol. This makes charcoal enough. The alcohol, which is worth more than the charcoal, used to be lost in the smoke.

“Thousands of years ago, before there were any men in the world, those parts of the earth where the great coal fields now lie, were covered with marshes and lakes. It was very warm, much warmer than the hottest countries are to-day, and a great deal of rain fell, so that the trees and ferns and plants grew to a very great size, much larger than any trees and plants that we know. There was much carbon in the air, and carbon is good for plants, while animals cannot live in it. So there were no birds in the trees; but there were insects, such as spiders, beetles, and locusts; and there were enormous reptiles and many kinds of fish, and shells

and corals in such numbers as to form thick beds of limestone."

"How do they know that?" asked Walter.

"The fallen trunks of great trees have often been found in the coal beds, and there are always



Fossil Fern Leaf.

fossils of leaves and plants in the coal seams, or in the clay under the coal seams, and sometimes there are fossil remains of fishes or reptiles."

"What are 'fossil remains,' Papa?"

"They are the forms of plants or animals, from which all vegetable or animal matter has disappeared,

so that only the stony outline is left ; or they are the marks in the clay or rock, showing where the plant or animal fell in the soft earth ages ago. The clay under the coal beds is full of these marks, and the coal itself has fossils of plants. If you make a fragment of coal thin enough to put under a microscope, you will see the outline of leaves or roots.

"Do you remember what happened last year to the peat bed by the railroad tracks, when we had had no rain for a long time ?"

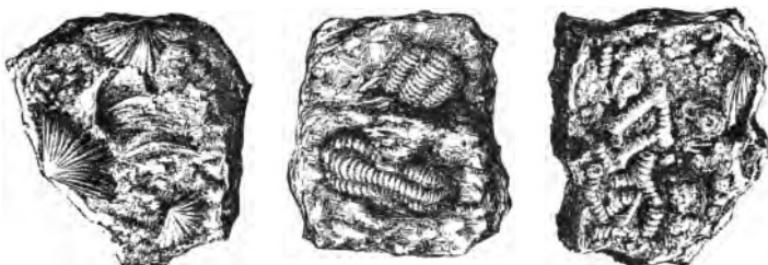
"Yes, Papa, the marsh all dried up," said Walter. "A spark from the engine fell into the peat bed, and set it on fire. We could not put it out, and there was a little fire still burning when the snow came."

"Yes," said Mr. King, "and that peat bed shows how coal began to be formed. You have often seen the moss that grows there. The roots of that moss die every year, but the tops send out new roots, and this process goes on year after year, till the mass of dead roots is very thick. These dead and decaying roots become matted together, and the mass, which is called peat, may be cut out and used to burn. In Ireland peat is the principal fuel of the peasants.

"The peat cutters take the moss from the top, and save it to plant again, because they know it is the moss that makes the peat. They cut the peat in blocks, press out the water, and pile it up to dry.

"We don't use peat for fuel, but our peat bed would become a coal bed if it could lie undisturbed for thousands of years, though the coal beds have been formed by other kinds of plants beside mosses.

"While the coal was forming, the earth was cooling; and as it cooled it became smaller, and



Rock Fragments, showing Fossils.

the crust was broken, so that hills and mountains rose from the level surface. The beds of coal were disturbed; sometimes they were thrown up in mountains, and sometimes great rents were torn in them, and the broken places filled with rock.

"The greatest disturbance occurred in the anthracite region in Pennsylvania, on the eastern slope of the Alleghany Mountains, near the beginning of the range, and in Rhode Island.

"It is supposed that anthracite and bituminous coal were formed at the same time and in the same way, but that the greater heat and pressure made part of the coal harder and more compact."

XXVIII. FIRST USE OF COAL

"Coal is found in almost every part of the world," continued Mr. King, "and it has been in use for a long time. A wise man of Greece wrote about it more than two thousand years ago, and said it was used by smiths.

"It was burned in England about seven hundred years ago, but the chimneys were poor, and the black smoke and disagreeable odor of the soft coal made people think that the air was poisoned, and they asked Parliament to forbid its use. Their petition was granted in the time of Edward I, and the offense of burning coal was punished by death.

"Fifty years later Edward III allowed the people of Newcastle to 'dig coals and stones.' Newcastle is still a famous coal market. You know we often say 'He is carrying coals to Newcastle,' when a man is doing superfluous work.

"In America the Indians knew about coal and were making some use of it, when the first white men came. A bituminous mine was worked in Virginia before the Revolutionary War; the coal

was used in blacksmith shops, and, to some extent, in fireplaces. During the war it was used in making cannon balls.

"A few years later anthracite coal was found in Wyoming Valley, Pennsylvania. It was called 'stone coal' because it was like a very hard coal



River Transportation of Coal.

already known in England. But the English stone coal would not burn, and the first attempts to burn anthracite coal here ended in failure. It was crushed, and used to make roads.

"In 1769 a blacksmith, named Gore, succeeded in making a fire of the 'stone coal' in his forge. Soon after that this kind of coal was used in all the blacksmith shops in that part of the country; but

it was nearly fifty years later before it began to be used in grates.

"Philadelphia was the first city to adopt the new fuel; but the introduction was made slowly and with great difficulty, because it was so hard for people to learn to let a fire alone. They would put it out by poking and raking. In one rolling mill a cartload of coal was wasted in starting a fire, and then the firemen worked all night trying to make a second cartload burn. Tired out, at day-break, they shut up the furnace, and went to breakfast. On their return they found the coal at white heat."

XXIX. OPENING A MINE

"At first the coal mines were owned by individual miners; but when it became necessary to go deeper into the earth, the small owners sold or leased their claims to those who had more money; and then the men who had thousands of dollars sold or leased to those who had hundreds of thousands, because it cost so much to get the coal that lay so far from the surface.

"In the bituminous regions there are still individual owners and small companies, because the soft coal can be mined at less expense.

"Sometimes a seam of coal is found under good farm land. In that case the farmers lease the coal mine to a coal company, and go on with their regular work, as if there were nothing of value below the surface. The openings to these seams are made from the land owned by the company, so that the farmers are not disturbed.

"When a mine owner is about to open a mine he examines the surface carefully. First he looks for outcrops, or coal appearing at the surface. Then

he follows the banks of the stream (if there is a stream) to find exposed coal seams. If he finds one, he measures its thickness, and finds out its 'dip' and 'strike'; that is, he finds out at what angle the seam goes down into the earth, and the direction of a horizontal line drawn across the seam. He notes the strata of rock or sand or clay, because these may tell him whether he is likely to find other seams above or below.

"In the Wyoming Valley red sandstone often lies above the coal. So if he finds red sandstone in that valley, he expects to find coal also. A very hard rock, called 'conglomerate,' made of quartz pebbles held together by lead-colored cement, is found under the lowest coal seams. Whenever conglomerate appears, he knows that there is no coal beneath it. He may drill through the strata in search of coal. All this is called 'prospecting.'

"In some places coal can be cut out in large pieces, just as stone is taken from a quarry; but most mines are opened in one of four ways, by 'drift,' 'tunnel,' 'slope,' or 'shaft.'

"The first coal mines were opened by drift. When a seam of coal was exposed in a cliff or hill-side, the miners dug directly into it, and brought the coal out in wheelbarrows. If a stream of water ran at the base of the cliff, the coal was thrown

down into a boat. If there was no water, a wagon road was made, a platform built over it, and the coal thrown down into wagons. The drift is still used in some cases; but the opening is wide enough for two car tracks, one for bringing out the coal, and one for the return of the empty cars.

"The roof of the drift is supported by timbers, and the floor must be made so that the water can run out freely, for water is almost always found in a mine. The incline of the floor makes it easier to push out the loaded cars. The drift is the cheapest of the four ways of entering a mine, because coal can be taken out at once, and sent to market.

"The tunnel is made in the hillside to meet the coal seam, instead of directly entering the exposed coal. The slope begins in the outcrop and follows the dip of the seam.

"But most mines are now entered by a shaft, which extends downwards sometimes many hundreds of feet. One must spend thousands of dollars before he can take out coal. A space is marked out on the surface somewhat larger than the finished shaft will be. From this the earth is thrown out until rock is reached. Walls of masonry are built up from the rock, to keep the earth from caving in. Large timbers can be used instead of stone, and the timber lining is called 'cribbing.'

"The shaft is now about twelve feet wide, and thirty feet long, and is divided into four compartments, which extend to the foot of the shaft: a pumpway to take the water out, two carriage ways, and an air passage. These compartments are separated by partitions called 'buntons.' The ends of the buntons are set in the rock. They are about four feet apart, and are boarded closely together down the whole distance. Where the boards meet the rock, the spaces are filled with mortar, to make the passages as nearly air tight as possible.

"On each side of the carriage ways, extending from the top to the bottom, are strips of hardwood about six inches square. These are called 'guides,' and the carriage fits inside them. The carriage is a well-built platform, with posts at the middle of the sides, held together by a crossbeam at the top.

"To each side of the carriage is fastened a 'shoe,' which fits loosely on the guides, and helps to keep it steady when going up or down. The shoe is an iron box without top or ends. A wire cable is fastened to the middle of the crossbeam, to raise and lower the carriage. A track is laid on the platform, to connect with the tracks at the bottom and top of the shaft; so that the mine car full of coal can be easily run on or off the carriage. The car is held in place while on the track by blocking the wheels.

"At the top of the shaft there are 'cage rests,' to hold the carriage in place. When it is ready to go down, they are drawn away by hand levers; when it comes up it pushes them back, and they spring into place to support it as soon as it has passed.

"In almost every mine there is a safety carriage made of wrought iron. It has a roof to keep off anything that might fall down the shaft, and safety clutches to hold it still in case of accident.

"The miners go in and out, and the coal is brought up, through the main shaft; but small shafts are sunk into the seams of coal to admit fresh air. There are ladders in the small shafts but they are seldom used, unless the passage to the main shaft is cut off."



Safety Carriage.

XXX. GANGWAYS AND CROSSHEADINGS

"Now the mine owner is almost ready to take out coal. He has sunk the shaft to the bottom of the coal bed. He cuts a passage into the coal from each side of the shaft. These passages, ten to fourteen feet wide, are the beginnings of the 'gangways.' From the ends of the shaft he cuts passages, six to ten feet wide, and fifteen to thirty feet deep. These are the first 'crossheadings.' From the farther ends of the crossheadings passages are cut parallel to the gangways. These are called 'airways.'

"Now, Papa," said Walter, "you say the mine owner cuts these passages. Do you mean that one man does all this work?"

"Oh, no," said Mr. King, "the owner does not even plan the work. The mining engineers do that, laborers do the digging, carpenters build the shaft, and miners cut the coal. The owner opens a mine as Mr. Smith builds his new house—he gets men to do it.

"When the gangways and airways are about a hundred feet long, a new passage is cut out at right

angles to them. This is a new crossheading. All these passages are made in the coal; and on each side of the shaft are left two bodies of coal about thirty feet wide and one hundred feet long. These are called 'pillars' because they support the rock overhead about the shaft.



Passages in a Coal Mine.

"Under the shaft there is a basin, called the 'sump,' made to receive the water from the mine. The water is pumped from the sump and thrown out at the top of the shaft.

"When the gangway and airway have been driven two or three hundred feet, side openings are made for taking out more coal. These openings are called 'chambers' or 'breasts' in anthracite

mines, and ‘rooms’ in bituminous mines. The chamber is generally about twenty-four feet wide, though the entrance from the airway is narrower (only wide enough to admit the mine car), so that it can be easily closed if necessary, and also to protect the airway by leaving a greater body of coal in the pillar.

“A second chamber is made beside the first, separated from it by a pillar of coal about eighteen feet thick; and if the air is good, an opening may be made between the two chambers. As the mine is developed, many chambers are opened, and partitions are made across the airway to force currents of air into the chambers and back again into the airway.

“The main car track extends the whole length of the gangway; and from this track branch tracks are laid across the airway into each chamber up to its ‘face.’ The face is the farther side of the chamber.

“The work in the gangway and airway goes on as at first. If the gangway can be kept in good condition, without too much expense, it is sometimes three or four miles long; but if it has to be timbered, it is not driven more than a mile, because it is cheaper to build a new shaft. But the gangway can seldom be driven in a straight line. It must follow the coal seam, which sometimes curves

so much that it seems to be going back to the foot of the shaft. There may be streams of water across the seam; and broken places, called 'fissures,' which may be filled with solid rock, or with fallen pieces; or the seam on one side of a fissure may be higher than it is on the other side.

"It is impossible for the mining engineer to know what obstacle may lie in his way. The gangway may divide, and each division may divide again; and chambers may be made along each subdivision, or a new gangway may be built along the faces of the chambers, or just above them.

"If it is necessary to raise or lower a car from one gangway to another, an inclined plane is made, one end of a rope is fastened to a loaded car and the other end to an empty one, the loaded car goes down and the empty car is drawn up by the rope, which winds itself about a revolving drum at the head of the plane.

"The coal from all these chambers is brought down to the main gangway, and hauled by mules to the shaft, where the loaded cars are lifted to the surface. If the gangway is straight enough, a small locomotive may be used to draw the trains, or 'trips,' of cars; or, better still, an electric engine, which has neither smoke nor steam."

XXXI. MEN IN THE MINES

"In a small or new mine there may be only ten or twenty men employed, while some of the larger ones have hundreds or thousands.

"First, there is the 'mine boss,' who controls the whole working of the mine. He receives his instructions from the general superintendent, and reports to him.

"Next to the mine boss is the 'fire boss,' who looks after the ventilation of the mine. He goes into the mine every morning, before the men come to work, and examines all the places where dangerous gases are likely to appear, finds out whether the air currents are right, and cautions the men if he thinks there is any danger from bad air.

"The 'driver boss' has charge of the boys who drive mules and tend doors."

"What are 'doors' in a mine, Papa?" Walter asked.

"When new passages or chambers are cut," said Mr. King, "there is sometimes a new draft, strong



Miners and Laborers.

enough to change the direction of the ventilating current, so that some of the passages or chambers may be left without any fresh air. Then an air-tight partition is built across the passage, a door is made in it, and a boy is stationed there, to open the door when he hears the mule driver coming with the cars.

"Besides these men and boys, there are footmen, carpenters, blacksmiths, masons, tracklayers, miners, and laborers.

"In each chamber there are usually four men, two miners and two laborers. The miners are employed by the mine owner, and the laborers are hired by

the miners. The two miners divide their profits equally, and are called 'butties' instead of partners. The miners cut the coal, and the laborers wait on the miners, load the coal into the car, and clear away the rubbish.

"Before much coal has been taken from a chamber, it becomes necessary to support the roof. The owner provides hardwood props for this purpose, and the miners set them up along each side of the middle line of the chamber, wherever the boss may direct. If the roof is soft or slaty, it will take a good deal of the miner's time to set props."

"Every coal seam has two benches, the top bench and the bottom bench, separated by a thin partition of slate. The bench containing the best coal is cut first, because the blasting necessary to take out the slaty or bony coal would make the clean brittle coal too fine to use."

"What is 'bony' coal?" asked Walter.

"It is coal mixed with slate or clay," said Mr. King.

"Suppose the miner has a wall of clean coal at the face of his chamber. He has ready all his tools and materials for work. A miner's drill is a bar of iron tipped with steel. The steel end is flattened to form a blade or chisel, slightly curved at the edge, and a little wider than the bar. The other end is

round on one side and hollow on the other. He selects a point on the bench of coal, and strikes it with the steel-tipped end of his drill; and as he repeats the blows, he turns the drill slightly in his hands to make the hole round. He may use a machine hand drill, which is worked by a crank, and forces its way into the coal like an auger. It is harder to turn the crank than to strike with the drill; but it cuts the coal faster.

"When the hole is about four and a half feet long, it is cleaned out with a scraper, a light iron rod with a handle on one end and a spoon on the other. Then a cartridge is put into the hole, and pushed as far as possible. A cartridge is a tube of manila paper filled with black powder, and folded at the ends. Then an iron rod, called a needle, is pushed into the hole, till the point pierces the outer end of the cartridge. The needle is left in the hole.

"The miner takes fine dirt from the floor of the chamber, moistens it, if it is dry, pushes it into the hole beside the needle, and presses it against the cartridge with the head of his drill. More dirt is pressed in, until the hole is full, and the packing firm. The hollow in the blunt end of the drill allows it to avoid the needle, and at the same time fill the hole. This is called 'tamping.' When the tamping is finished, he turns the needle gently, and

draws it out. This leaves a small hole for the entrance of the 'squib.'

"The squib is a long slender firecracker. If the hole bored by the drill is very wet, a copper tube is put in to hold the needle, and when the needle is drawn out the squib is put in. If inflammable gases are present, or there is any other reason to fear that the cartridge will explode too soon, a piece of cotton wick is dipped in oil, and attached to the fuse to lengthen it.

"The tools are taken away; a lighted lamp is touched to the fuse; the men cry 'Fire,' to warn those who may be near, and hide behind a pillar, to wait for the fire to reach the squib. The explosion of the powder in the squib sends it forward to the cartridge, and the explosion, which follows, breaks off a large piece of coal. Then the men go back, push the coal away, and the miner drills another hole. This is repeated five or six times, to take out a bench of coal to a distance of five or six feet.

"The miner can seldom stand upright and bore directly into the face of the coal. He considers how he can obtain the best results, and bores the hole accordingly. Sometimes he holds the drill as high as possible above his head; sometimes he kneels; often he lies on his back or side, on the wet floor.

He keeps his powder chest in the chamber, as far as possible from the 'facé,' the place where he is working. In the chest, which is always locked, are the things that he needs about his work: such as powder, cartridge paper, a cartridge pin, squibs, lampwick, and chalk.



Miners and their Tools.

"Near the face are his picks (the mining pick, straight and pointed, used to bring down coal or slate from the face or roof; and the bottom pick, longer and curved upward at the tops, used by the laborers in breaking up the coal after it has fallen), two drills, sometimes a machine hand drill, a steel crowbar, an eight-pound steel hammer, with a long

handle, used for setting props, a sledge for breaking coal, and three large scoop shovels.

"His lamp is necessary, for without it he could not even find his way to his work. It is a round tin box with a flat bottom and a hinged top, a spout on one side and a hooked handle on the other. He hooks the handle into his cap. There is a cotton wick in the spout for burning crude petroleum. Electric lights are used in the gangways of some mines, and will probably soon be in use in the chambers.

"The miner buys his own tools. The powder, fuse, and oil are supplied by the owner and charged to his account.

"His work is done for the day when he has cut coal enough to make the number of carloads required by the owner. Sometimes, when the coal is good, and he meets with no accidents, he gets through at ten o'clock in the morning, and he rarely works later than two o'clock in the afternoon. He never stays to help the laborer, who takes up the coal, loads it on the car, runs the car down to the gangway, takes care of the slate and useless coal, and clears the chamber for the next day. The laborer does not finish his work till four or five o'clock in the afternoon; but he expects to be a miner, and then he will have shorter hours and better pay."

XXXII. DANGER IN THE MINES

“The great pillars that support the roofs of the chambers contain about half the coal of the whole mine, so the pillars must be ‘robbed,’ after all the coal has been taken from the chambers. The robbing is begun at the face of the chambers at the farthest end of the mine. If too much coal is taken off, the pillar breaks, and the slate and rock fall down into the chamber. Sometimes the men are crushed beneath the falling mass.

“The roof of any mine may fall, because the pressure of the earth and rock from above the mine is too great, or because there are too few props, or because the blasting has been carelessly done. The fall may come suddenly, or there may be signs of its approach, such as cracks in the roof, small pieces of slate dropping to the floor, pillars bulging in the middle, and bits of coal breaking from them with a crackling sound. When these things happen, the mine is said to be ‘working,’ and every effort is made to support the roof.

“Sometimes the floor is so soft that the pillars

settle, or they may pierce a soft roof. Or the pillars may 'slip,' or move downward. This happens only when the incline is very steep.

" Then there are the poisonous gases. The gas found most frequently is called 'marsh gas,' because it is made by vegetable matter decaying under water. The miners call it 'fire damp.' It accumulates in cracks or open places in the coal, and often comes out suddenly in a great volume, called a 'blower.' The miner's drill may set it free at any time; and his lighted lamp coming in contact with it may produce a terrific explosion. When he finds that there is danger from fire damp, he falls flat on the floor, and buries his face in the dirt to protect it from the intense heat; but if he waits too long, he will be overcome by 'after damp' or 'choke damp,' gases produced by the burning of fire damp.

" 'Black damp' does not burn. Its presence is shown by the dimness of the lights, which grow fainter and fainter, until they go out entirely. It is heavier than air, and settles in the bottom of the mine. It is swept away from the working faces by the currents of air forced in by the ventilating machinery; but it accumulates in abandoned chambers, and sometimes it gathers at the foot of the shaft.

" 'White damp' is dreaded most of all the gases,

because a very little brings instant death, and it is almost impossible to detect its presence. It rises, because it is a little lighter than air; it has neither taste nor color, and it does not affect the flame of the lamp. It is sometimes produced by an explosion of blasting powder.

"In a very dry mine coal dust may explode when mixed with air, as the result of a heavy powder blast, or the fall of a roof. This is more likely to happen in a bituminous mine.

"Besides the dangers from falling roofs and poisonous gases, there is the terrible danger of being lost in a mine. You can hardly understand, Walter, what a fearful thing it is to lose one's way in the black darkness, and to grope about in the narrow passages in the constant dread of meeting deadly gases, or of falling into water in the abandoned chambers."

XXXIII. BOYS AND ANIMALS IN THE MINES



A Coal Car in the Mine.

"The mules that draw the loaded cars to the shaft and take the empty ones back to the chambers, are almost as glad as their boy drivers

when the day's work is over. They step on the platform of the carriage that takes them up to the surface, and show no sign of fear or discomfort during the ascent. Sometimes the stables are built in the mine, and then the poor creatures never come out of the darkness. The drivers go down, before seven o'clock in the morning, to feed them and get them ready for work by the time the miners need the cars. These dark stables are often infested with rats that grow to a great size, and increase in numbers very rapidly. They are bold and fierce and will fight to death in self-defense or to protect their fellow rats."

"How do the rats get into the mine, Papa?"

"No one knows," said Mr. King, "though it is supposed that they go down with the hay and feed for the mules.

"Miners think it a bad sign if rats leave the stables; they expect some accident, such as the falling of a roof. Sailors say that 'rats desert a sinking ship.'

"The driver leads his mule to the foot of the shaft, and hitches him to a 'trip' of empty cars. There are generally four cars in a trip. The boy climbs into the forward car, cracks his whip, and starts off.

"When he comes to the first chamber he is to supply, he unfastens the first car and drives into the chamber with it. He unhitches the mule and leads him back to the three cars left in the gangway. He leaves one car at each chamber on his route, and at the last chamber he finds a loaded car waiting at the foot. He leaves the last empty car, takes the loaded one, and goes back to the shaft, attaching a loaded car at each of the other three chambers as he passes.

"All the light he has comes from the lamp in the front of his cap. He must be sure of his way in the dark passages, manage his mule, be careful not to be caught between the cars, and quick enough to keep from being crushed between the passing cars and the pillars of coal or the props in the chambers.

"Then there are the door boys, who sit alone in the darkness all day long, to open the doors in the closed passages, when they hear the driver boys coming with their mules and cars."

"Can't they have any light?" asked Walter.

"Yes, each boy has a lamp in his cap, but it does not give light enough to read by; and many of the boys are so poor that they put out the light to save expense. They lead the most lonely life of all the workers in the mine."

XXXIV. THE COAL BREAKER

“Near every coal mine there is a large building called a ‘breaker,’ in which the coal is screened and sorted. Sometimes, in older mines, the breaker is built over the mouth of the shaft; but this is now forbidden by law, which requires that ‘no breaker, or other inflammable structure, shall be erected nearer than two hundred feet to the opening of a mine.’

“So, for convenience of sending the coal away on the railroad, the breaker is often built in a valley, and, if possible, is placed so that the coal cars may be run directly to the head of the breaker from the mouth of the shaft.

“When this cannot be done, the coal is taken up to the highest part of the breaker by a hoisting engine; the car is run by two headmen to the scale platform, and then dumped on the ‘chute bars’—which are long parallel iron bars set about two and a half inches apart, and enough inclined to allow the coal to slide down.

“The small coal, with the dirt, falls through into a hopper, from which it goes to the screens, one on each side of the hopper. The dirt is thrown out,

and the coal is carried to another set of revolving screens, where it is again cleaned, and separated into the sizes which we know as 'egg,' 'stove,' 'chestnut,' and 'pea' coal, and also a very small



Coal Breaker.

coal called 'buckwheat.' From the screens these different sizes of coal are sent down separate chutes which are lined with sheet iron, and the stone and slate are picked out as it slides along.

"The large coal, which slid down the iron bars,

goes by another chute to heavy iron rollers, which are set with strong iron teeth so that the teeth of one are opposite the open spaces of the other. The surface between the teeth is perforated, to avoid crushing the coal. As it comes from the rollers it is screened and sent down over other bars and through chutes until it comes to the picking chute.



Interior of Coal Breaker.

"The picking chutes are narrow troughs, across which seats are fastened so that boys who pick out the stone and slate may sit facing the slowly moving stream of coal. They throw the waste into a trough beside the chute, and it slides away. The boys at the head of the chute see more stone and waste

coal than they can pick out; they who sit next below must look a little more carefully; and the third set of pickers need sharp eyes to see what the others have left. Most of these boys are in the picking room; but there are slate pickers all over the breaker, wherever their work can be done to advantage. Pickers are stationed at the refuse chutes, to pick out the good coal that is often accidentally thrown away.

"The coal at last runs into bins, which are built over the railroad track, high enough to let coal cars stand under them. These bins are closed by gates at the end, and the cars are loaded by opening these gates and allowing the coal to run into the cars.

"The very fine coal is called 'culm,' and is dumped in a pile separate from the stone or slate pile. It is used to fill in trestlework under railroad tracks, and to make foundation for pavements. In Europe it is mixed with some pitchy material and pressed into bricks, which are used for fuel; but in this country it costs too much to make these bricks. Poor people come to the waste heaps with hammers and screens, and find good coal for their home fires, and carry it away in bags, baskets, or wheelbarrows.

"But we must not talk about coal any longer to-night, for you must be up bright and early to go nutting to-morrow."



The American Robin.

XXXV. WHAT WALTER FOUND IN THE HICKORY TREE

One day in early spring Robert lost his curls, and this was the way it happened.

"Julie Tealeaf, Julie Tealeaf," Robin Redbreast was singing out on the lawn ; but Julie Tealeaf did not answer.

"Julie Tealeaf, Julie Tealeaf, Julie Tealeaf," sang Robin again ; still Julie Tealeaf did not answer. She was Mrs. Robin Redbreast. She was sitting on her nest in the top of the hickory tree, and was very tired, for she had been working hard, building her nest with the tiny twigs and wisps of grass that Robin brought her. Now she wanted a soft lining for her nest.

Early in the morning Robin called her to look at a piece of lace. The lace looked very pretty, as it lay on the grass, where Aunt Mary often gave them crumbs. Julie Tealeaf thought Aunt Mary had left it there for her friends, the robins. So she took it in her beak and flew away. She used it to bind her nest together, for it was just what she wanted to make the nest stronger, and now all she needed was a lining.

Robin had been very unlucky. He had called for her many times. But she had found nothing that would do at all for a lining for their pretty nest; and she was too tired to fly down again, when he called louder than ever, "Julie Tealeaf, Julie Tealeaf."

"I suppose I must go," she said; "but I don't believe he has anything I shall want."

Robert and little sister had been playing on the lawn all the morning. They had gone in to dinner now, and had left a little heap of shining stuff at the foot of the big tree.

Robin Redbreast was hopping around it. He was calling: "Julie Tealeaf, Julie Tealeaf, see what I have found! It is finer than gold and softer than silk."

Mrs. Robin Redbreast gave him a cheerful chirp, then seized a beakful of the golden threads and flew back to her nest.

Robin Redbreast was so happy that he could hardly keep from singing; but he followed his wife with all he could carry. Back and forth they flew, till their nest had a lining soft enough and pretty enough to satisfy Julie Tealeaf.

The door of the house flew open. Out came Robbie, and his little sister, Papa and Mamma, and Walter. Grandpa and Grandma came too. Robbie's yellow curls were gone, and the whole family was searching for them in the grass. Robin heard the little girl say that Robbie was sitting under the tree when she cut his hair.

"Here are the scissors," said Mamma; "and here are three curls. The wind must have blown the rest away."

When the north wind began to blow, Robin Redbreast and his family flew away. When Walter climbed the tree to shake down the nuts that frosty day in October, he cried, "See what I have found — Robert's curls in Robin's nest."



XXXVI. IRON

During the summer Walter had often gone to the blacksmith shop to get some piece of the farm machinery repaired. While he was interested in Mr. Lee's work, he had been too much occupied with the sowing, planting, cultivating, mowing, and reaping, to ask many questions about other things. But after he had learned something about coal he wanted to know a little about iron; so one evening he said, "Papa, please tell me about iron."

"Well," said Mr. King, "iron is the most useful of all metals."

"More useful than gold?" asked Walter.

"Yes," said his father, "gold is useful chiefly because all men have agreed to take it for everything else, while iron is essential to all our work, as well as to our health and comfort. If I want to buy a new machine, it would be difficult for me to take a hundred bushels of wheat to exchange for it; and the man who owns it might not happen to need wheat. But I can easily sell the wheat, and take gold to buy whatever I need. You see gold represents the

wheat; while the machine that I wish to buy could not be made without iron. Without iron we could not sow the seed, or cultivate or harvest the crop, or take it to market; neither could we prepare our food, or build our house, or keep it warm. We use iron so constantly that we cease to think about it any more than we think about the air we breathe or the water we drink.

" Iron can be molded into any form, drawn out to any length or fineness, spread into sheets or plates, bent, welded, sharpened, hardened, softened, made tough or brittle. It is found in almost every country in the world, and in more than half the states of the Union. The most ancient history mentions iron and iron workers; and the use of iron has steadily increased as nations have advanced in civilization.

" It is taken from the earth; but no one knows how it came to be there. There is no record of its beginning, as there is of the beginning of coal. It is found in the form of sand or gravel, in ledges of rock, sometimes on the surface, sometimes buried deep in the earth. The soft ores are simply shoveled out, while the hard ore is mined like coal. Iron ore is often found with veins of coal and ledges of limestone; so that the materials for making iron are all at hand.

“The best iron is made by mixing ores from different mines; and some ores must be carried long distances to find coal and limestone for smelting.”

“I don’t understand what limestone has to do with making iron,” said Walter.

“It is used in smelting the ores,” said Mr. King, “and is called a ‘flux’; because, when heated, it causes the iron to melt more quickly, and it takes up the waste, so that the melted iron is much more nearly pure.”

XXXVII. ORE DOCKS



Ore Dock.

" You remember the great ore docks that we saw last year in Two Harbors? They are built to ship the ores from the rich mines in our own state to the eastern smelting furnaces near the coal fields. The shortest dock is seven hundred and fifty feet long, and the longest ones are a thousand feet in length. Great breakwaters are built in the lake to keep the waves from dashing into the harbor. Piles are driven as far out as the docks are to go, and the spaces are filled with stone up to the

surface of the water. Trestlework forty feet high is built on this foundation, and a railroad track is laid on the trestle. The ore cars run on this track.

"The ore cars are built so that the bottom can be let down. They are loaded at the mines—twenty-five tons of ore in each car, and twenty-five cars in a train. An engine draws the heavy train down on the dock; the doors in the bottom of the cars are opened; the ore falls into the storage bins within the trestle under the track; a vessel is drawn up alongside the dock; the hatches are opened; the great spouts from the bins are let down; and the ore pours into the hold till it is full. Then the spouts are lifted; the hatches are fastened down, and a tug steams away with the vessel, while another comes up to the dock.

"These vessels leave their cargo of ore at the lower lake ports, and bring back coal to the upper lake ports. The ore is then taken by rail to the furnaces."

XXXVIII. PIG IRON

"The ore is first melted in a blast furnace, which is made of iron lined with fire brick. It is about



Smelting Furnaces.

eighty feet high, and smaller at the bottom and top than in the middle. The top is closed by a heavy cone-shaped damper, which is lifted by machinery. At the bottom there is a great tank, called the 'hearth,' to receive the melted iron. The space

between the walls about the hearth is filled with running water to protect the lining from the intense heat: Above the hearth are the pipes through which the blast of hot air is forced into the furnace.

"The stoves which heat the air are huge cylinders divided into chambers. The air passes through all the chambers before it goes into the furnace. There are three or four stoves for each furnace; and the air gets heated to a temperature of eleven hundred or twelve hundred degrees. The stoves are heated by burning the gas that comes from the coal, which makes the coke for the furnace.

"When the furnace is ready to be filled, the iron and limestone are crushed into small pieces and put in with the coke. Every barrow load of each material is weighed to get the right proportions, to avoid waste. The fires are lighted, the hot air is turned into the pipes, and the roar of the blast begins.

"When the iron is melted, it settles in the hearth. The limestone, with much of the waste, floats on the top of the melted iron, and may be drawn off first. It is called 'slag'; and when cool it looks like coarse rock, though the slag from some varieties of ore is fine in texture, and glassy in appearance.

"At the base of the furnace there is a bed of sand, in which channels have been made at regular



Making Pig Iron.

intervals. A long deep channel from the furnace leads to the shorter ones in the sand. The blast is shut off, and the hearth opened. A stream of white metal runs down the main channel, and men are stationed by the shorter channels to see that the last one is filled before the iron is too cool to reach it. As soon as the iron cools, the shorter pieces are broken off. They are about forty inches long, and three and a half or four inches square. They are called 'pigs,' or pig iron."

XXXIX. WROUGHT IRON

“ Pig iron is not pure iron, and cannot be used till it is freed from the other matter. So it is broken into chunks and put into the puddling furnace.

“ This is longer than it is high, and has a sand floor and a vaulted roof. Magnetic ore, or iron that contains oxygen, is placed on the floor. The fire is built at one end, and the chimney is at the other; so that the flame must pass through the pile of pig iron. When it softens, the oxygen of the added iron unites with the waste of the pig iron and forms cinders.

“ While the pig iron is softening, a man stirs it with a long iron rod, which he puts through a hole in the door of the furnace, so as to bring every piece in contact with the air, and with the iron that has been put in. The pure iron appears in small globules. When the puddler sees this, he says it is ‘coming to nature,’ and makes up the little globules into a ball containing from sixty to eighty pounds of iron. The assistant opens the door,

and the ball, held by long tongs, is taken to the 'squeezer,' a machine which rolls the ball into a cylinder, and forces out the cinder. The cylinder is rolled into bars, which are cut up and heated again. This is repeated several times. Experience and a good deal of skill are required to tell just when to remove the ball. It must be heated to just the right heat, and a delay of a minute may spoil all the iron. This iron is called wrought or malleable iron."



XL. STEEL

"The old way to make steel was to place bars of wrought iron in a furnace, and bury them in charcoal. The charcoal was set on fire, and the air was shut off. The slow burning continued about two weeks. When the bars were taken out, they were covered with blisters, and had to be melted to make the metal of uniform quality. This was called 'cast steel.'

"Steel is now made directly from pig iron, and is called 'Bessemer steel,' from the name of the inventor, Sir Henry Bessemer, of England; though the methods of making steel used in our country are different from the English methods. The impurities are burned out, and steel is produced in about thirty minutes, instead of almost as many days.

"Pig iron is heated red-hot. A great pear-shaped crucible (called a converter, because it converts the iron into steel) is heated to a white heat. It is swung on hinges, and turned to receive the red-hot iron, and then set upright. In the bottom are a hundred or more tubes, a quarter of an inch in diameter, through which air is forced at a very

great pressure (twenty-five pounds to the square inch). This high pressure keeps the melted iron from filling the air tubes. The noise of the bubbling metal and the roar of the air blast remind one of a volcano; while sparks of dazzling white-



Interior of Foundry.

ness pour out in a steady stream. In about half an hour the stream of sparks ceases, and a glow of white heat follows. That means that the waste matter is burned out, and that the almost pure metal is left.

"There is still a little oxide of iron, which must be taken out. So a small quantity of iron containing manganese (called 'spiegel iron') is added. Part of the manganese takes up the oxygen of the oxide of iron, and rises as slag; the rest of the manganese remains in the metal, and changes it from iron to steel. Now the converter is turned so that the melted mass can be poured out into a ladle, which is lifted, by machinery, to run the metal into molds. When cold, it is ready to be sent to the rolling mills, or it may be hammered into any shape desired."

XLI. THE WHEAT MARKET

"Now, Walter," said Mr. King, "we'll take a load of wheat to market."

The horses were harnessed, and the wagon box was filled with bags of wheat, when Walter took his place on the high seat beside his father. As they drove into the village, Mr. King said, "Wheat must be dull to-day, for there are no buyers in sight." But when they turned a corner, a man called, "What have you there?"

"Wheat," replied Mr. King.

The man climbed up on the load, and untied a bag. "That is number one, hard," he said, and offered to buy; but Mr. King would not sell when wheat was so low, so he turned his horses' heads toward the elevator near the railroad station. He told the man in charge that he wanted to store his wheat, and drove on the platform scale in the elevator to weigh his load. Then he poured the wheat into the hopper, and threw the empty bags back into the wagon which was still standing on the scale to be weighed again. This weight, called the

"tare," was taken from the weight of the whole load, or gross weight, and that gave the weight of the wheat, or the net weight. The man gave Mr. King a receipt for the wheat, which he called a "storage ticket."

From the hopper the wheat ran down to a pit under the scale, from which it was taken up by heavy tin cups, fastened to a belt, which passed over a cylinder at the top of the building, so as to draw up the full cups, and empty them into a spout, through which the wheat poured down into a bin. The bins were numbered, and the different grades of wheat were kept in separate bins. A record was kept of the weight of wheat in every bin.

While Walter was looking at the wheat, a freight car was pushed up the track, under a spout leading from one of the bins. The door of the car was open, and the inside door was let down; the spout was opened, and the wheat ran into the car till the car had its load; then the car was closed and sealed and moved away, and another car was sent up.

"How do they know when the car is full enough?" Walter asked.

"Do you see how this first car is marked?" asked his father.

"Capacity twenty thousand pounds," read Walter.

"That means that this is an old car," said Mr.

King, "and was built to carry twenty thousand pounds. The man in the weighing room of the elevator knew that this car was waiting to be filled, so he weighed twenty thousand pounds of wheat and sent it into one of these bins over the track,



Car receiving Wheat from Elevator.

which are called 'shipping bins.' You see, the next car is marked 'Capacity eighty thousand pounds.' That is one of the best new freight cars, and there are eighty thousand pounds of wheat for it in another shipping bin."

"There is a car coming now, marked 'Capacity sixty thousand pounds,'" said Walter.

"Yes," said Mr. King, "and in one of the shipping bins there are sixty thousand pounds of wheat waiting for it."

"There is a car loaded with oats," said Walter; "and it is much nearer full than the one like it, loaded with wheat."

"There are more bushels in the carload of oats," said Mr. King, "but not more pounds; because a bushel of oats weighs only a little more than half as much as a bushel of wheat. The carload seems larger, because oats are more bulky than wheat. That means that they take up more room."

"I thought wheat was always sold by the bushel," said Walter.

"So it is," said his father; "but it would take too long to measure a carload of bushels, so it is weighed, to find out how many bushels there are in the car. Our wheat is 'number one,' and will weigh sixty pounds to the bushel; but all wheat that weighs fifty-eight or more pounds to the bushel is called number one; number two wheat weighs from fifty-six to fifty-eight, and number three from fifty-four to fifty-six; but sixty pounds must be given for a bushel of any grade of wheat, although sixty pounds

of the lower grades would measure more than a bushel.

"In all wheat there is some dust, and a few seeds from weeds that have grown with it. In our wheat they will probably say there is half a pound of waste in every bushel; and we shall have to make reduction for that waste when we sell the wheat."

Just then a big freight engine steamed in; the loaded grain cars were coupled on, and one train-load of wheat started on its long journey.



XLII. THE ELEVATOR

"Walter has taken so much interest in all the farm work, and especially in the wheat crop," said Mr. King, "that I have planned my trip to the city to take him with me during his vacation." So, on the first holiday, John took them to the station; and when they were well on their way, Mr. King asked, "What would you like to see first?"

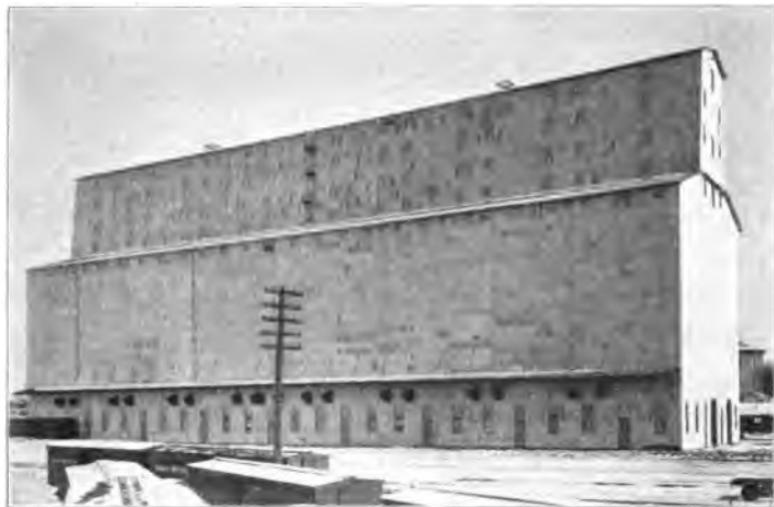
"What becomes of the wheat," said Walter.

"Very well," said his father, "as soon as I have attended to a little business, we will see about the wheat."

Mr. King knew the superintendent of one of the storage elevators, and readily obtained permission to go over the building. It was very large, and covered with plates of corrugated iron, to protect it from fire. "You see, Walter," said Mr. King, "that trains of cars are constantly passing on both sides, and a stray spark from an engine might kindle a great fire, as each of these elevators contains from half a million to about two million bushels of grain. But before we go farther, let us look at the cars on this track."

"There are no locomotives here," said Walter.

"No," said his father, "because all these cars must go into the elevator to be unloaded; and no engine is allowed within the building, not even the great engine that runs all the machinery. That is in the low brick building over there."



Grain Elevator.

The cars were filled with wheat; the car doors had been pushed back; and the inner doors, next to the wheat, had been pried up, so that they could be easily and quickly raised, when the cars entered the elevator. On the inner door were tacked cards, on which were written the number of the car, the amount of wheat it contained, the grade of the wheat,

and the name of the inspector (the man appointed by the state to examine the wheat and determine its grade). These cards were taken off and saved carefully. If the owner was not satisfied with the grading, another card was added, and the wheat was inspected again before it was taken into the elevator.

A man came out from the elevator carrying a great iron hook attached to a thick cable. As he fastened the hook to the first car, Mr. King said, "Now we must go in, Walter."

The cable was wound round an iron cylinder in the building, and passed through stationary pulleys beside the track. As the cylinder revolved slowly, the cable tightened and drew the car down the track into the elevator, and that car drew another behind it. When the first car stood over a grating in the floor, the second car had gone a little beyond a second similar grating. The iron hook was then attached to the second car, the cable tightened again, and the car was drawn back till it stood exactly over the grating.

In an instant two men had put crowbars under the sliding inner door, and shoved it up. The wheat poured out upon the grating. As soon as it was lowered enough, the two men entered the car with two large steam shovels, which they set up in the wheat. The ropes attached to the shovels

tightened instantly, and two shovelfuls of wheat were pushed out. The men drew the shovels back, and the same thing was done again.

As soon as the floor in the rear of the car was uncovered, a man climbed in with a broom, and began to sweep the scattered wheat up to the pile in front. Soon the big shovels had taken most of



Interior of Grain Elevator.

it out. Then the men leaped over to the platform, laid down the shovels, seized brooms, and sprang into the car again. All three swept the rest of the wheat out as quickly as possible. Then two more cars were drawn in by the cable, and the two new cars pushed the first ones off down the track, to make way for themselves on the gratings. All

the men who were unloading wheat, wore handkerchiefs or sponges tied over their mouths and noses to keep out the dust, which rose from even the cleanest wheat.

"What is that man going to do, Papa?" asked Walter, pointing down the track.

"He is going to sweep the cars again," said Mr. King. "He will find a few kernels in the corners of the cars, and he will sweep a few out of the cracks. He will feed this wheat to his chickens, or sell it to his neighbor, or possibly to the owner of a feed store, if he gets enough."

"But we are forgetting those carloads of wheat. Do you see these two long upright boxes that look like posts? Through the glass on this side, you see what seems to be a sheet of tin moving rapidly. These are tin cups riveted to a leather belt. Each cup holds from eight to sixteen quarts of wheat; but the belt moves so fast that you can see neither the cups nor the wheat; only the glitter of the tin, as the cups are carried along. They are carrying the two carloads of wheat to the garners in the highest part of the building. While the wheat is going up, we will go to the weighing room on the floor just below the garners."

Mr. King opened the door to a little passenger elevator, and they began the ascent. The elevator

shaft was boarded as closely as a mine shaft because, in case of fire, a long open shaft would make a strong draft, and carry the flames from one floor to another.

At the weighing room they stepped out and looked at the great scales, each one big enough to weigh a whole carload of wheat. A huge hopper rested on each scale. The narrow space, between the hopper and the ceiling, was covered with canvas to keep the dust from flying into the weighing room, when the wheat came down.

When the two carloads of wheat had been taken up to the garners, the man at the foot of the elevators (the long upright boxes) made the signal to the man in the weighing room. The signal showed not only that the wheat had gone up, but to which scales it would come down. The weigher moved the levers at the scales indicated, and the wheat poured down — one carload into each hopper.

When it had all come down, the weigher stamped the weight on a weighing card, noted the date, the number of the car, the initials on the car (which showed to what railroad company it belonged), the kind of grain weighed (whether wheat, oats, flax, barley, rye, or corn), the grades of grain, how much allowance was made for waste, on what scale it was weighed, and in what bin it would be stored.

The state weighmaster then came and examined the scale and the record, to make sure that no mistake had been made. Then the hoppers were opened and the wheat began to run down to the bins.

"Come, Walter," said Mr. King, "let us follow the wheat"; and they went down to a large room, where there were a great number of large, round iron covers over holes in the floor. These were the covers over the tops of the spouts that led to the storage bins. A large jointed spout, from the hopper of every scale, connected with these spouts, and could be turned to lead the wheat directly from the scale into any of these bins.

There were more bins at the farther end of the building, which were fed by means of an endless belt extending the whole length of the very long room. The belt was about five feet wide, and the wheat, poured in from the spout, lay along it in a thick wide strip.

"Now they are going to fill one of the side bins," said Mr. King, as the men moved the machine called the "tripper" along under the belt, to turn the wheat into the spout leading into the bin. This was called "tripping wheat"; and the wheat from the swiftly moving belt could be tripped into any of the bins.

"What keeps the wheat on that belt?" asked Walter.

"The engineer would tell you it was kept in line by 'centrifugal force,'" said Mr. King. "You will learn about it when you are a few years older."

"The wheat is stored in these bins till it is wanted for use, when it is drawn off through spouts in the bottom of the bins. It is again taken to the garners and sent to the scales, and is carefully weighed into the shipping bins, and poured into freight cars, that come up on the track under the bins, as you saw in the little elevator at our home station. Then it is taken directly to the mills, to be made into flour, or it is sent away to eastern cities, or across the sea."

"Besides the wheat stored in these great elevators, millions of bushels are shipped over the Great Lakes in the vessels that come back loaded with coal."

XLIII. BUYING WHEAT

Many cars still stood on the tracks farther up in the railroad yard. While Walter and his father were looking at them, a man with a pointed brass rod climbed up on a car and plunged the rod into the wheat in three or four places.

"What is he doing?" asked Walter.

"He is taking samples of wheat," said Mr. King. "That brass rod is a 'plunging rod.' It is hollow, and has a row of holes along the side, and there are slides within. It has a handle on the top, by which the holes are opened and closed. They are closed when he thrusts it into the wheat; then he turns the handle and opens the holes, and the wheat runs in. He pours the wheat into a little bag, which is marked with the number of the car. This enables him to get wheat from almost every part of a car-load. When he has tested all the cars that are ready for him, he takes the samples to the owner of the wheat, who puts them in dishes, and sets them on a table in the room where grain is bought and sold."



Bidding for Wheat.

"Now suppose the supply of wheat for one of the mills has run short. The buyer for that mill comes in and says, 'I want forty carloads of wheat today.'

"The wheat men show their samples. The buyer is accustomed to handling wheat, and knows the grades as soon as he sees the grain. If the quality of the wheat and the prices suit him, he says, 'I'll take this car, and this car, and this car,' till he has as much as his mill needs.

"Or he may not be able to buy as much as he

needs in this way, and will be compelled to go into the 'pit,' which we shall see this afternoon."

When Mr. King opened the door of the room where they were selling wheat, Walter almost turned back.

"What a dreadful noise! What are they doing?" he said.

"Only buying and selling wheat," said his father.

A crowd of men stood before a platform, shouting and wildly gesticulating, and almost climbing over each other in their eagerness to attract the attention of the man on the platform. Walter thought they were all out of their minds. But when the bell struck, the uproar ceased, and they walked out in a quiet, orderly way that convinced him that they were sane men after all. His father explained that the shouting was only their way of bidding, and that the gestures had a meaning, which could be understood when their voices could not be heard.



A Flour Mill.

XLIV. THE MILLS

In the morning Mr. King said, "We will go to one of the great flour mills to-day."

There were cars standing on the mill track, and steam shovels were unloading wheat when Mr. King entered the office and asked if they might see the mill. Permission was readily given, and one of the millers went with them to explain the different processes, and also to see that they did not go into dangerous places.

The wheat from the car fell through the grating into the scale hopper. It was weighed and was again weighed by the state weighmaster, and records were made as before in the elevator. The cards tacked to the inner door were also carefully saved. A red card showed that the wheat had come from one of the storage elevators; a white one, that it had come direct from the country.

As soon as it was weighed it was lifted to the top of the mill, and passed through a separator to take out straws, sticks, or anything that might have fallen into it, and then it was stored in bins. As it was needed for grinding, it was drawn off through spouts, and taken by a "conveyor" to other separators. The conveyor was a long, covered, wooden box in which an iron shaft with flanges revolved rapidly, and sent the wheat along, as chips are sent out by the spiral groove of an auger. The separators were great fanning mills, in which the wheat fell in thin cascades from one screen to another, while the chaff, dust, and seeds were blown out by a strong current of air.

After the wheat had been made as clean as possible in the separators, it was scoured by a coarse stiff brush that polished the kernels, and took off the little bunch of tiny hairs that grow at one end of every kernel of wheat. This made the wheat clean

enough unless there was "smut" among the kernels, a fungus that often grows on ears of grain and makes them turn black. Whenever smut was found the wheat was washed.

It was then carried by another conveyor to the steamers, and subjected to heat. If very dry, it was moistened with water, but it had been raining when this wheat that Walter saw was brought in, and the miller said it had taken enough moisture from the damp air.

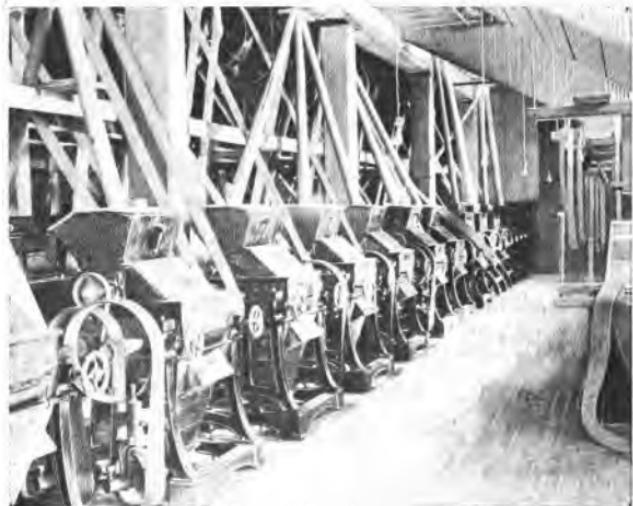
After it had been heated in the steamers, it passed along to the drier, where the dampness was carried off by a current of hot air. "All this," the miller said, "is to toughen the outer coating of the kernel, so that it may be taken off as nearly whole as possible, and also to 'temper' the wheat."

"What does it mean to 'temper' the wheat?" asked Walter.

"Sometimes the wheat is too dry to make flour," said the miller, "sometimes it is too wet; some of it may be very cold, while another part may be warm. After it has passed through the steamers and drier, it comes out equally moist and warm. This we call 'tempering the wheat,' and on the success of this process depend largely the amount and quality of the flour."

The wheat was then ready for the rollers. The

first set cracked the kernel and let the germ fall out. The second set made it a little finer, and the third broke it into small pieces. Then it went on to a machine containing many sieves, some coarse and some very fine, in which it was separated into many different parts. Walter could not understand



Grinding Wheat.

all this, but the miller said he need only remember that the bran fell from one spout in this machine, the germ from another, middlings from a third, and fine flour from still another.

The bran went on to be packed for feed; the germ was sometimes made into a kind of breakfast food; while the middlings and flour passed to another set

of rollers, where they were again crushed, and sent into a purifier, which took out all the remaining woody fiber, that might otherwise color the flour. From the purifier the fine flour went directly to the packer, while the middlings that still remained returned to the rollers to be ground again.

The packer was a cylinder, over which a sack was drawn. Within the cylinder, an auger-like shaft received the flour from the conveyor, and pressed it into the sack which rested on a movable platform. As the sack filled it came down with the platform. A sharp click told the miller that it was full and the packer thrown out of gear; he took it away and put an empty sack in its place. He weighed the filled sack, and if it was not heavy enough, added some flour from the barrel that stood by his side, or if it was too heavy he took out some.

Another man sewed the sack up with coarse linen twine, and passed it to a truckman who wheeled it to the waiting freight car, if it was intended for the home market. If it was to be sent across the sea, the cotton sack was inclosed in a sack of heavy burlap to protect it from dust and dampness.

Some of the flour was packed in barrels, and the barrels were rolled down an inclined plane and across a platform, with force enough to carry them up a similar inclined plane into the car.

The cars were prepared for the sacks by a lining of clean brown paper, and a layer of fresh bran on the floor. When they were loaded and pushed down into the yard, a big freight engine steamed in and carried them away.



Packing Flour.

As they were about to leave the mill after Walter had thanked the miller for answering all his questions so kindly, the miller said, "Here is one more thing that I am sure you would like to see," and he opened a door to show the wheat moving on an inclined belt.

"This machine is taking out the wild mustard seed," he said. "The separators take out all kinds of seeds except the little smooth round mustard seed, and how to get rid of that has always been a problem for millers. If this belt were too steep, some of the wheat would fall back; if it were not steep enough, the mustard seeds would go on with the wheat. At just the proper angle the little seeds roll back, fall into a pit under the machine, and are taken away by the car load to be made into oil, somewhat like linseed oil, though not so good."

"That is an elevator for the use of the men who work in the mill," he explained, as Walter started at sight of a man's feet coming down through the ceiling. He was clinging to an iron handle riveted to a wide belt, while he stood on a bracket, which was also fastened to the moving belt. The men swung themselves on and off this simple contrivance with the greatest ease, though strangers were not allowed to go up and down in that way.

"How much machinery, and how many men it requires to take care of one crop of wheat!" said Walter.

"Yes," answered his father; "and while they all depend on us for their bread, we could do very little without their help. We need the blacksmith to keep our tools in order, the machinist to make them,

the miner to dig the iron and coal, the elevator men to store our grain, the miller to make it into flour, and the railroad men and sailors to carry it to market."

"But though I like to see the various kinds of work," said Walter, "I think farming is the best of all, and I would rather be a farmer than anything else in the world."

"That is well, my boy," said Mr. King, "but remember that the farmer who is really useful to the world is the one who can 'make two ears of corn, or two blades of grass, to grow upon a spot of ground where only one grew before.'"



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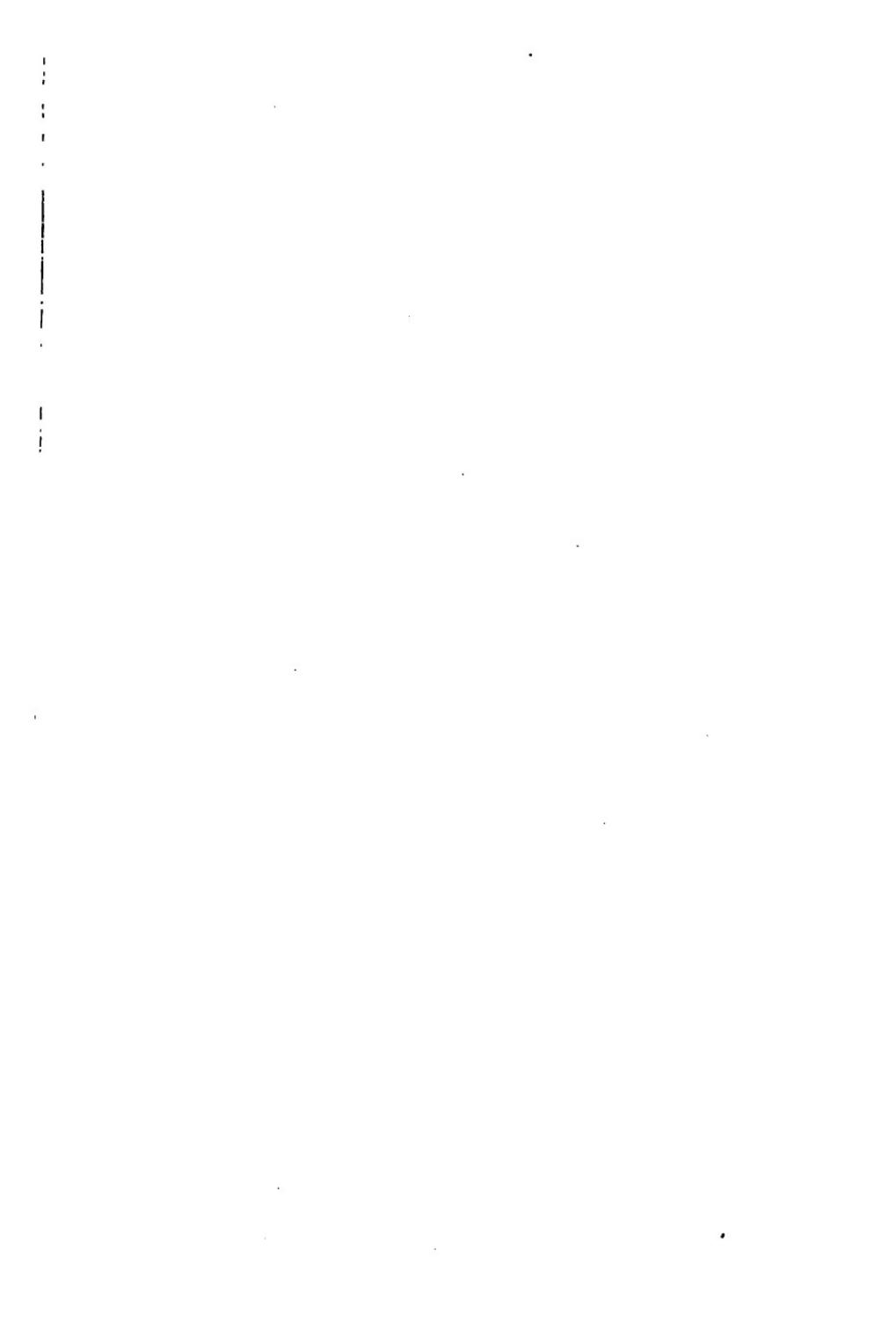
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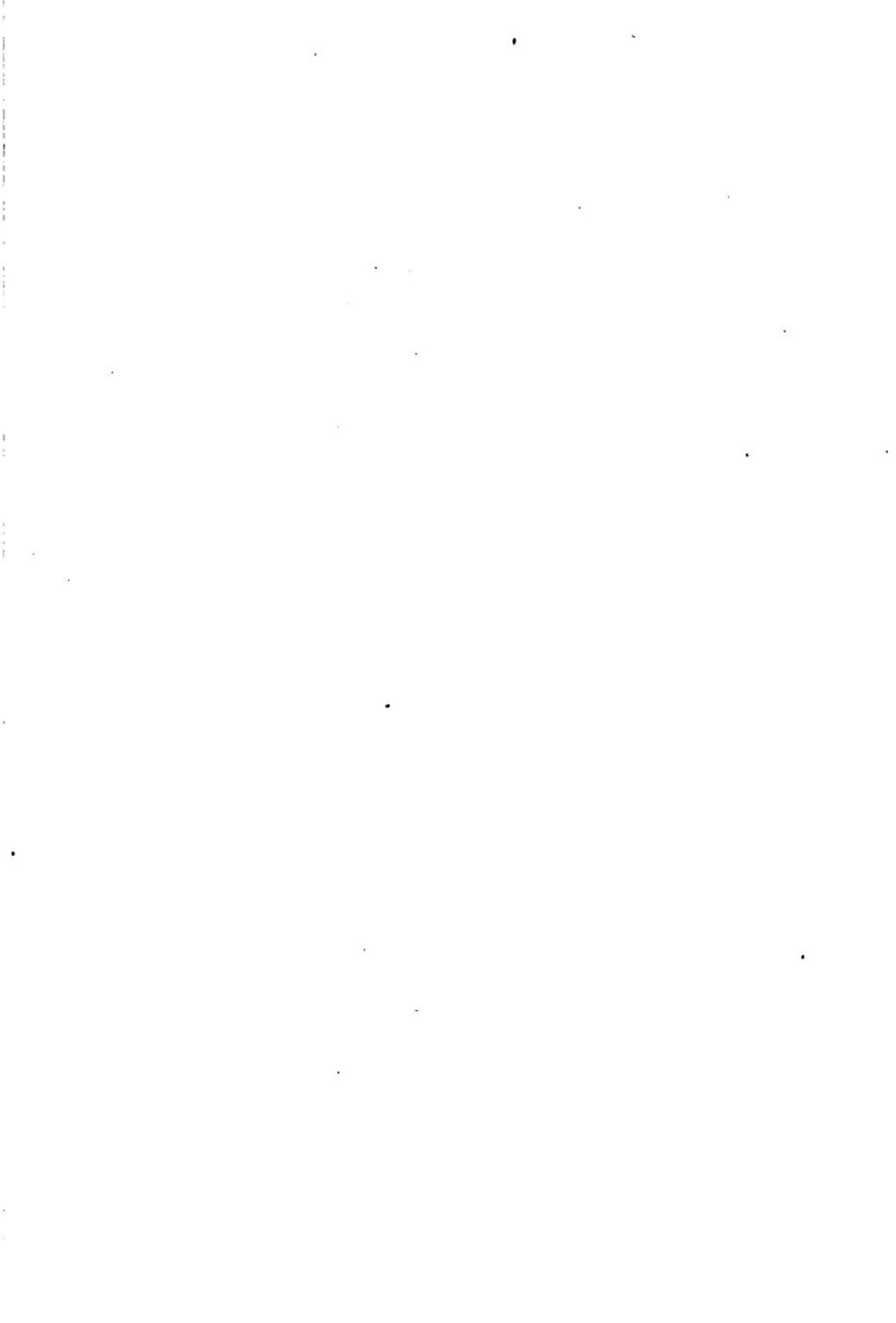


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A black and white photograph of a vertical metal bookshelf. The shelves are labeled with cards. The top shelf has a card that reads "LIBRARY. SCHOOL OF EDUCATION, STANFORD".

